THURSDAY, FEBRUARY 4, 1915.

THE WEB OF LIFE.

Tierbau und Tierleben in ihrem Zusammenhang betrachtet. By Prof. Dr. F. Hesse and Prof. Dr. F. Doflein. Band ii. Das Tier als Glied des Naturganzen. By Franz Doflein. Pp. xv + 960 + plates. (Leipzig and Berlin: B. G. Teubner, 1914.) Price 20 marks.

ONE of the fundamental ideas of biology, which found many illustrations in the work of Darwin, is that of the inter-relatedness of organisms in the web of life. Just as there is a correlation of organs in the body, so there is a correlation of organisms in the economy of nature. No creature lives or dies to itself; the orbit of one life influences many others; everywhere we find linkages and wheels within wheels. An organism is compared by Prof. Doflein to a modern house, connected by various pipes and wires with other houses in the city and with the outer world, but the image is crude and too static. It is only in man's personal affairs that we find anything like the manifold, intricate, and subtle inter-relations that are to be seen in vigorous animals leading a full life. It is, indeed, altogether a matter of action and reaction between organism and environment, but with what complexity and nuance! Now things are in the saddle coercing the organism, and again the living creature exercises its prerogative and becomes master of its fate.

Prof. Doflein, Weismann's successor at Freiburg, has been studying this aspect of animal biology for more than ten years, and has given us his results in a work which must be placed in the front rank among ecological or bionomic studies. The book is nothing short of a great achievement. It has gathered interesting material from many fields; it includes much that is personal; it has worked out a clear classification of the manifold inter-relations; it is written in a vivid style; and if we said all we think about the abundance, freshness, and beauty of the illustrations, we should not be believed. We do not know of any British, American, or French book of natural history that even approaches it—a fact doubtless implying a smaller purchasing public. Prof. Doflein is well known for his work on the Protozoa and as a naturalist-traveller, and it is remarkable that he should have found time during the last ten years to write this large volume, a fit companion to its predecessor, by Prof. Hesse of Bonn, which treated of the organism as an individual.

In dealing with the comprehensive subject of the inter-relations of animals in the web of life, Prof. Doflein has evidently had in his mind throughout two allied, but distinct, general conceptions. The first is that of the organism as a bundle of adaptations to normal circumstances—what he calls "organisatorische Anpassungen"; the second is that of the organism as a self-assertive plastic agent, which can adjust itself to environmental vicissitudes—what he calls "regulatorische Anpassungen." The first is the hereditary racial equipment of wrought-out adaptations (as far as these concern give-and-take with animate and inanimate surroundings); the second is the individual capacity for adjustment, for modification, for thrusting as well as parrying. In both cases the adaptiveness may be structural, or functional, or psychical. Thus a ptarmigan from the mountains has a stronger heart than a willow-grouse from the plains—a structural adaptation. A bird or mammal continuously and normally regulates its production of heat according to its loss—a functional adaptation. Ants have an instinctive behaviour in relation to their queens—a psychical adaptation. But when a mammal transported to a cold country puts on a thicker coat, or when a bird adjusts the nature of its food-canal to altered diet, or when ants taken from Algiers to Switzerland entirely alter the door of the nest (in relation to new enemies), we have to deal with structural, functional, and psychical adjustments which are not more than individual reactions. This distinction between racial adaptation and individual adjustment is prominent in the book, but the author does not use it stiffly. He is clear, for instance, that the individual trades with his talents.

Beginning with the animate environment, Prof. Doflein deals with nutritive relations (including symbiosis, commensalism, parasitism, etc.); relations to enemies (including protective resemblance, mimicry, autotomy, etc.); sex-relations; migrations; care of offspring; social relations (including gregariousness, co-operation, and the communities of ants, bees, and termites). After 750 pages on these attractive themes, he passes to the inanimate environment, and deals with cosmic periodicities, the medium, the substratum, pressures, chemical influences, the quantity and quality of the food, temperature, climate, and light. This part of the book is like Semper's well-known work, "The Natural Conditions of Existence as they affect Animal Life" (1881), brought up to date. The volume ends with a discussion of the theoretical significance of adaptive structures and habits. What is new is the synthetic treatment of the whole question of inter-relatedness, which is, of course, fundamental in any biology

worthy of the name, and the wealth of fresh material that the author has collected from far and near. Among the interesting plates, we may refer to those illustrating symbiosis, protective coloration, wild geese, the courtship of capercaillie and blackcock, cave animals, and phosphorescence.

As we pass from this valuable treasury of bionomics, many reflections rise. We recognise the impossibility of understanding details of structure apart from details of environment—a commonplace, of course, but illumined by some of the subtle instances that Doflein gives. We appreciate the light that the manifold inter-relatedness of organisms throws on the value of even small variations. The selective process has to be envisaged in relation to the web of life. We realise afresh the importance of the organism's active agency. It is modified by its environment and it is adapted to its environment; but there is more, it actually adapts the environment to itself. And, finally, we are filled once more with wonderment at the vision of life slowly creeping upwards through unthinkable ages, asserting itself insurgently amid a callous physical nature. All that the author of this fine work has told us confirms the impression of a deep tendency to inter-linking and systematisation—the Darwinian *systema naturae*—which is more than a mere image of what obtains increasingly, in spite of all rendings of the web, in the progress of mankind.

J. ARTHUR THOMSON.

ASSAYING AT THE ROYAL SCHOOL OF MINES.

Assaying in Theory and Practice. By E. A. Wraight. Pp. xi+323. (London: Edward Arnold, 1914.) Price 10*s.* 6*d.* net.

THIS book will be welcomed by all assayers who appreciate the value of the teaching at the Royal School of Mines, and is of special interest to old students of the School, for the reason that it gives an account of the methods of assaying which have been taught there during the last few years. Almost all the notes issued to the students in the laboratory are contained in the book, and, in addition, besides other matter, the author gives some general remarks which will be of use to mine assayers and prospectors. Mr. Wraight is well equipped for the task of reminding his former students of what he has taught them. He was for some years the senior demonstrator in the assay laboratory of the Royal School of Mines, and in that capacity has been able to command the attention and affectionate respect of all who have come under his guidance. His work has only recently passed into other hands.

Mr. Wraight has made no attempt to write a complete book on assaying. The number of methods given is comparatively small and the gaps are considerable. For example, no mention is made of the volumetric methods of assay of silver bullion, or of the dry method for antimony, or of any method at all for platinum. The author observes that he has some thoughts of preparing a second volume containing analyses of ores, slags, etc., and of iron and steel. It may be hoped that he will include in it much besides these important sections.

As might be expected by those who know the author's work, there are few mistakes to be found in the book, and none of much importance. The method of determining silver in gold bullion given on p. 153 is an untrustworthy one, which is becoming obsolete. The method of parting with cadmium is not given. On p. 182 it is stated that graphite is not attacked by basic oxides. On p. 297, in the estimation of protective alkali in cyanide solutions, a decinormal solution of nitric acid is recommended instead of the usual oxalic acid or the fairly satisfactory sulphuric acid. The book certainly deserves a place on the shelf of works assayers. As a concise and clear statement of well-tried methods, it could scarcely be improved.

T. K. R.

JAPANESE MATHEMATICS.

A History of Japanese Mathematics. By D. E. Smith and Yoshio Mikami. Pp. vii+288. (Chicago and London: The Open Court Publishing Co., 1914.) Price 12*s.* net.

NOW that Europeans are becoming acquainted with the history of mathematics in Japan, it is possible for them to form a kind of general opinion about the work of Japanese mathematicians. Unless future research bring to light works of a calibre superior to those now known, we must acquiesce in the conclusions stated in the terminal pages of the present work. Briefly, they are that Japan has not originated any great and far-reaching theory, such as the infinitesimal calculus, or function-theory, or group-theory; while on the other hand, native methods of great ingenuity, applied to particular problems, did lead to equivalents for such things as Horner's method in solving equations, the general rule for computing a determinant, and a large number of ways of calculating π, some including the use of infinite series.

Another thing in which the older Japanese mathematicians excel is in dealing with a set of

simultaneous equations; they are not baffled by the occurrence of huge coefficients in the course of elimination, and contrive to solve equations of incredibly high degrees. Finally, the elegant designs of familiar things, such as toys, fans, etc., suggested equally elegant problems of a quite distinctive kind, such as the Gion Temple problem, an account of which is given, pp. 197–8. The first solution involved an equation of degree 1024, which was successively reduced (we are told) to 46 and 10—the last by Ajima, who seems, so far as we can judge, to have been the greatest mathematician of his nation up to the present time.

The fourteen chapters of this book are all interesting, but we can only point out a few of the topics. There is an excellent account of the way of using sticks and abaci for calculation, and of the early system of notation; this is followed by showing how the same implements were used to solve equations, after the manner of Horner. Coming now to the third period (1600–1675 or so) we have circle-rectification of an Archimedean type, magic squares and circles, and something like a theory of quadrature. Seki Kōwa is the leading figure of the time, and chapter vi. is entirely devoted to him, and gives abundant evidence of his talent and ingenuity. The authors, however, class him rather with C. Wolf or Barrow than with Newton or Leibnitz. Chapter vii. deals with Seki's contemporaries and the probable importation of some western mathematics through contact with the Dutch.

Chapter viii. is on the *yenri*, or "circle principle." Practically, this means the formulæ connected mainly with cyclometry, some of which are essentially infinite series such as we have in analytical trigonometry (*cf.* for instance, pp. 152–3). Matsunaga worked out π to 50 figures in the eighteenth century.

Of the remaining chapters the most notable is that on Ajima Chokuyen (1739–1798). Among his achievements may be mentioned his (analytical) solution of Malfatti's problem, and his anticipation of Steiner by discovering poristic rings of circles touching each other and two given fixed circles. He also dealt with repeating decimals, diophantine problems, and quadrature; in the last he comes nearer than any of his predecessors to the idea of a definite integral as the limit of a sum. He may possibly have been influenced by European work.

A special feature of the book is the large number of illustrations. Those which are diagrams for problems are always elegant and often remarkably beautiful (*e.g.* pp. 96, 185, 186, 198, 240, 245); others are very instructive, like those of the abaci, pp. 30–31.

We cannot help asking ourselves: What is likely to be the trend of Japanese mathematics for the next generation or so? Japanese students are now made acquainted with the vast structure of European mathematics, and it is too massive and too much based upon the fundamental nature of things for them to ignore. If they are to add to it, they must become acquainted with it, unless they go on making pretty little things that the master-builders will put into their proper place. But it would be a great pity if, in striving to contribute to the substantial parts of the building, the Japanese were to bury their special talents, innate sense of asymmetrical beauty, and exceptional endurance and power of taking pains. Such things as on one hand celestial mechanics, and on the other diophantine analysis, seem admirably suited to their genius; if there be a planet of the solar system beyond Neptune, or if there be a proof of Fermat's last theorem, a Japanese is as likely to discover it as anyone. G. B. M.

PRACTICAL EDUCATION.

(1) *A Handbook of Vocational Education.* By Dr. J. S. Taylor. Pp. xvi+225. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 4*s.* 6*d.* net.

(2) *A Class-Book of Commercial Knowledge.* By E. J. Balley. Pp. iii+125. (London: G. Bell and Sons, Ltd., 1914.) Price 1*s.* 6*d.*

(1) THE aim of Dr. Taylor's book is to give "a systematic survey of the general field of vocational education, embodying both the historical and logical aspects of the subject." But the author has not done full justice either to the subject or to himself by the short summary he has produced. With the introduction, pleading for equal opportunities for all, for education for citizenship, for a due recognition of the bearing of the industrial revolution on the teaching of trades, English opinion will be in full sympathy. So, too, with later chapters insisting on the need for guidance in the choice of an occupation, and on the part that trade schools should play in making good the loss of the thorough, all-round training afforded by the old apprenticeship system at its best. But the historical account of industrial education in Europe, given in chapter ii., is far too sketchy to be of real value.

Germany, and in Germany the admirable continuation school system of Munich, designed and built up by Dr. Kerschensteiner, holds pride of place, and the constructive side of Dr. Taylor's book may be said to be based on Dr. Kerschensteiner's principles. In his whole-hearted devotion to this master, who has exhibited in rare

combination the talents of administrator as well as teacher, he forgets how much of Dr. Kerschensteiner's success is due to conscription. It is a conscript army that has rendered possible conscript continuation schools, and the iron discipline of the whole system of higher education in Germany. The essential condition of reform in continuation school work in Great Britain and in the United States is to secure there, as has been done in most German States, that young persons who have left the elementary school and gone to work shall continue their education in day, not night, classes. But the hope will be nursed on both sides of the Atlantic that this end will be achieved by some milder political measure than conscription.

As regards the training of vocational teachers, few will refuse assent to Dr. Taylor's contention that "a teacher of trades must be expert in two arts—the art of teaching and the art of some craft." Theorising on the subject, educationists tend to give excessive prominence to its pedagogic aspect. In practice they are forced to act like business-men, and to accept a working compromise.

The bibliography is quite inadequate. Perhaps the most notable omission is that of Dr. Stanley Hall's great work on "Adolescence." Even an American book should acknowledge the world's debt to that distinguished American philosopher.

(2) Few words are needed to commend Mr. Balley's "Class-book of Commercial Knowledge." It is an excellent little book, and should be of the utmost value in secondary schools where some introduction to commercial studies is at last being recognised as desirable. The form of the book is good, for it is planned like an up-to-date text-book on other secondary-school subjects, the examples are modern and business-like, the specimens of business documents bound up with the text are a pleasure to handle, and may even stir the imagination of a future captain of industry. The author has succeeded in his object, viz., to show that the subject of commerce is both educative and interesting. Bookkeeping proper has been wisely left alone, as a separate subject. In a new edition more might well be said in section iii., dealing with office work, on modern methods of card-indexing and filing.

OUR BOOKSHELF.

Świat I Człowiek. By A. Heflich and S. Michalski. Vol. iv. Pp. 355. Second Edition. (Warsaw: Published by the Editors, 1913.) Price 2 roubles.

UNIQUE in its kind and of broad educational value is a Polish publication organised in Warsaw some years ago and edited from the beginning by Messrs. Al. Heflich and St. Michalski. The whole work, the aim of which is to help the self-educator in all the principal branches of scientific knowledge and scientific method, consists of three series: (i) "A Guide for Autodidacts," (ii) "Man and the Universe" (the universe in the light of the theory of evolution), and (iii) "The History of Thought." The recently-published second edition of vol. iv. of the second series contains a very interesting exposition of social evolution among animals and men, and of moral evolution, by Dr. L. Krzywicki, a thorough chapter on evolution of psychical life, by Dr. M. Borowski; further, an exposition of evolution in art, by Dr. W. Tatarkiewicz; and, finally, an inquiry by Dr. Fl. Znaniecki into the meaning of evolution of man and of the universe.

The present volume closes a large circle of ideas developed in the three first volumes which, after an introductory treatment of the concept of evolution in general, bring the (advanced) private student face to face with the facts and problems of universal and terrestrial evolution, of the evolution of plants, animals and man, of human civilisation, of language and economic life. The "Guide" proper (series I.) consists of several independent volumes covering the needs of the self-educator in the departments of mathematics, natural sciences, philology and history, sociology and law, and philosophy.

It may not be out of place to mention that the whole publication, which, since 1898, has been circulated in many thousands of cheap but beautiful volumes, is entirely supported by the Mianowski-Fund, a national institution of great social utility, and by the disinterested labours of the editors. L. SILBERSTEIN.

Crystallography: an Outline of the Geometrical Properties of Crystals. By Prof. T. L. Walker. Pp. xiv+204. (New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd., 1914.) Price 8*s.* 4*d.* net.

THE theodolite form of goniometer was invented, and the advantage of determining the position of a face on a crystal by a pair of co-ordinate readings of a single setting was pointed out almost simultaneously by a German, Goldschmidt, and a Russian, Fedorov. The method had, however, been used some years before by an Englishman, Miller, but the posthumous paper in which it was used escaped general notice. It is, however, largely due to the teaching of Goldschmidt and the series of researches carried out by him and his pupils that the convenience of the two-circle measurement of crystals has become widely recognised.

Prof. Walker is imbued with the Goldschmidt spirit, and essays in the volume before us to remove the reproach that no text-book on crystallography written in the English tongue is based on that method. We think that his effort has been crowned with but qualified success. The discussion of the different classes of crystal symmetry and the types of symmetry characterising

each, which occupies the greater part of the book, follows the ordinary, old-fashioned lines, even to the use of the Millerian indices, and the author has wisely refrained from complicating the discussion by devising a brand new set of names for the several classes. The sections on the Goldschmidt method are, on the other hand, scattered throughout the book; it would have been wiser to collect them together and to have expanded them. The argument is incomplete. For instance, the fundamental property of the gnomonic projection, viz., that all zones are represented by straight lines, is very indefinitely stated, and not proved at all. Examples of working out crystals belonging to the six systems should have been included in the several chapters, instead of reprinting more or less fully at the end of the book a few original papers, in which the actual working is subservient to the interest of the particular research. For a full understanding of the Goldschmidt method the student must still refer to the original source.

We are informed that the Hill Publishing Co., Ltd., are the London publishers, but their name is not given on the title-page.

First Book of Physiology and Hygiene. By Gertrude D. Cathcart. Pp. vi+158. (London: Macmillan and Co., Ltd., 1914.) Price 1*s.* 6*d.*

It is apparently the notion in certain educational circles that hygiene can be taught without a preliminary knowledge of the science physiology on which it is founded. If such an idea still lingers anywhere it will be immediately dispelled by a perusal of this attractive little book. The author shows quite clearly that the laws of health are direct deductions from physiological principles. These are explained in clear, simple language, so free as possible from technical terms, and we can highly recommend the book as suitable for readers commencing the study of the subject, or for those who do not wish to take it up from the professional and medical point of view. Where so much is excellent, it seems ungracious to point out a serious mistake, the only one so far as can be ascertained; this is the erroneous statement that the red blood corpuscles are the carriers of carbon dioxide.

W. D. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Density of Lead from Ceylon Thorite.

LAST MAY, in conjunction with Mr. H. Hyman, I published the result of an examination of the relative atomic weight of a small specimen of lead, less than one gram, separated from a kilogram of Ceylon thorite, which showed a value rather more than a unit in excess of that found for a specimen of ordinary lead. I have since been engaged in extracting the lead from 33 kilograms of Ceylon thorite, which was first carefully sorted by hand, piece by piece, into various grades. From the finest grade, consisting of 20 kilograms, about 80 grams of lead were obtained, in agreement with the percentage obtained by analysis.

This specimen, and a similar weight of ordinary assay lead, have been carefully purified by identical processes, and finally obtained as metal, by fusing the oxide with cyanide, and repeating the fusion with the metal. The very porous castings so obtained were melted in a mercury pump vacuum in glass tubes with drawn-out jets, and cast into cylindrical graphite moulds in the vacuum, hydrogen to atmospheric pressure being then admitted, and the lead allowed to freeze from the bottom.

It was thought that a determination of the specific gravity would yield results of interest. It is to be expected that the atomic volumes of isotopic elements should be identical, so that, on this view, the densities should be in proportion to the atomic weights. The density of lead distilled in a vacuum was found, by Kahlbaum, Roth, and Siedler, to be 11·3415 ($D^{20°}_{4°}$), and after pressing to 10,000 atmospheres, 11·3470. For the ordinary lead, prepared as above detailed, $D^{20°}_{4°}$ was found to be 11·3465, as the mean of three determinations agreeing within 8 units in the last place, in good accord with that found for distilled lead. On the other hand, the value found for the specimen of thorite lead was 11·376, which is 0·26 per cent. greater, and higher than has been found previously in any trustworthy determination. The atomic weight calculated from the density, taking 207·10 as the figure for ordinary lead, is 207·64. It remains to be seen whether the constants of the lead will be altered by further purification, but one would expect that the effect of any possible impurity would be to decrease, rather than increase the density.

During the purification of the lead, bismuth was specially looked for, but, if any at all was present, its quantity was certainly less than one part in ten millions of the mineral. This seems to dispose of the speculation that bismuth is one of the end products of the thorium disintegration. On the other hand, I was surprised to find a perceptible quantity of iodine in the mineral, and separated between one and two grams, which Mr. J. A. Cranston is now examining. So far as the tests have yet gone, there seems to be a distinct trace, also, of thallium present.

FREDERICK SODDY.
Chemical Department, Aberdeen University,
January 30.

The Cause of Streaks upon Lath and Plaster Walls.

IN reply to Mr. Thomas D. Cope's letter in NATURE of January 21, it may be stated that he is correct in supposing that the best explanation of the streaks on the plaster he refers to is that they are due to the hot-air molecules driving the dust particles into contact with the plaster, and the colder the plaster the weaker is the power of the cold-air molecules next it to resist the deposition. This tendency of hot air to deposit its dust on cold surfaces can be seen in a very marked way in any house heated with hot water or steam. Wherever a hot pipe comes through a wall there will always be found a dirty vertical streak on the wall just above the hot pipe, caused by the stream of hot air rising from the pipe depositing its dust on the cold surface.

This action of hot air on cold surfaces accounts for the difference in cleanness of surfaces in rooms heated by open fires, and those warmed by hot air or by the so-called radiators, which do most of their heating by warming the air by contact. In a fire-heated room the furniture is principally heated by radiation, and, being warmer than the air, it repels the

dust; while if heated by hot air, the air heats the furniture, and in so doing deposits its dust on it. These remarks apply to the fine dust, and not to the larger particles which fall on the furniture, and do not adhere to it like the heat-deposited ones. Electric lighting keeps the ceilings much cleaner than gas. Much of this cleanness is due to the much lower temperature of the air rising from the electric bulb than from gas-lighting, but ceilings over electric lights show blackening, especially in smoking-rooms.

The cause of the streaks on plaster referred to by Mr. Cope may, however, be a little more complicated than stated above, because the plaster is porous, and some amount of diffusion will take place between the gases in the room and those at the back of the plaster, and as the laths will reduce the diffusion their action will, to some extent, aid their heat-conserving effect. The principal cause of the streaks would, however, appear to be the heat effect, as it will be generally found that, if the heating and other conditions are the same, the ceilings of the rooms on the top flat of a house are much more lath and beam marked than those underneath, owing to the upper surface of the plaster in the upper rooms being exposed to the cold air under the slates while the ceilings of the lower rooms are kept warmer by the rooms over them.

It is possible the difference in the plaster in the cold room referred to by Mr. Cope may be due not to any action of the water vapour, but to its condensation on the walls ingraining the dust into them.

The reply to Mr. Cope's last question is, yes. A reversal of the phenomenon is quite simple, and has already been referred to. Any surface hotter than the air keeps free of dust; a surface placed in a smoky chimney, if it is hotter than the gases, gets no soot deposited on it. A paper bearing on the above subject, and entitled "The Formation of Small Clear Spaces in Dusty Air," appeared in the Trans. Roy. Soc., Edin., xxxii., part ii.

In my letter in NATURE of January 21, the date of a letter there referred to is given as March 16, 1913, which should have been March 6, 1913.

JOHN AITKEN.

Ardenlea, Falkirk, January 26.

THE cause of these streaks, which are also often to be seen on ceilings, appears to be due to the fact that bodies which are warmer than the atmosphere are surrounded by a "dust-free space," and that dust is battered upon surfaces which are cooler than the atmosphere.

The dust-free space has been described by Tyndall ("Dust and Disease," Royal Inst., 1870), Frankland ("Dust and Disease," Proc. Roy. Soc., vol. xxv., p. 542), Rayleigh (Roy Soc., December 21, 1882; NATURE, vol. xxviii., p. 139), Aitken (Roy. Soc. Ed., January 21, 1884) and Lodge and Clark (*Phil. Mag.*, March, 1884, p. 214).

Recently I have discussed the question of the discoloration of walls and ceilings (the *Engineer*, July 3, 1914) in an article on the "Theory of the Radiator."

In the above papers your correspondent will find answers to the questions he puts. R. M. DEELEY.

Abbeyfield, Salisbury Avenue, Harpenden, January 22.

Adelard of Bath and the Continuity of Universal Nature.

IN the recently published volume of "Roger Bacon Commemoration Essays" (1) Prof. Pierre Duhem's contribution, "Roger Bacon et l'Horreur du Vide," has for its main thesis that Bacon was the first to formulate a theory of universal continuity; an incorrect hypothesis, it is true, but one which Prof. Duhem believes to have served the useful purpose of supplementing "the peripatetic theory of heavy and light" until the discovery of atmospheric pressure. This theory developed in connection with certain problematical phenomena of which this "experiment" is the chief and typical case. If there is suspended in air a vessel of water having a hole in the top and several narrow apertures in the bottom, no water will fall from it so long as the superior aperture is closed. Yet water is heavier than air, and according to the principle of Aristotle's physics should fall to the ground. Writers before Bacon, according to Duhem, explain this anomaly by saying that the fall of the water would produce a vacuum, and that a vacuum cannot exist in nature. But Bacon argues that a vacuum cannot be the reason why the water does not fall, because a vacuum does not exist; he then explains further that although by their particular natures water tends downwards and air upwards, by their nature as parts of the universe they tend to remain in continuity. Duhem holds that Bacon was the first to substitute this positive law of universal continuity for the mere negation that a vacuum cannot exist in nature (2).

Prof. Duhem supports his case by citation of Greek, Byzantine, and Arabian sources, and by use of writings of fourteenth-century physicists available only in manuscripts. But unfortunately for his main contention he has overlooked that remarkable little treatise, "Questiones naturales," which Adelard of Bath, Bacon's countryman, wrote more than a century before Roger penned his "Questiones naturales" (3). In Adelard's fifty-eighth chapter his nephew says—the work takes the form of a dialogue between Adelard and his nephew—"There is still one point about the natures of waters which is unclear to me." He then asks his uncle to explain a water jar, similar to that just described, which they had once seen at the house of an enchantress. Adelard replies in his clear, easy style, so different from the scholastic discussion in Bacon's corresponding passages:—

"If it was magic, the enchantment was worked by violence of nature rather than of waters. For although four elements (4) compose the body of this world of sense, they are so united by natural affection that, as no one of them desires to exist without another, so no place is or can be void of them. Therefore immediately one of them leaves its position another succeeds it without interval, nor can one leave its place unless some other which is especially attached to it can succeed it." Hence it is futile to give the water a chance to get out unless you give the air a chance to get in. Finally, Adelard not only thus anticipates the theory of universal continuity, he describes what actually occurs in the "experiment" more accurately than Bacon or the other physicists cited by Duhem. "Hence it comes about that, if in a vessel which is absolutely tight above an aperture is made below, the liquid flows out only interruptedly and with bubbling. For as much air gets in as liquid goes out, and this air, since it finds the water porous, by its own properties of tenuity and lightness makes its way to the top of the vessel and occupies what seems to be a vacuum" (5).

LYNN THORNDIKE.

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(1) Edited by A. G. Little, Oxford, 1914.

(2) Bacon Essays, p. 266. "Le doctrine dont nous avons suivi le développement au travers des écrits de Roger Bacon semble bien lui appartenir en propre.

A peine, croyons-nous, en avait-il trouvé chez ses prédécesseurs un germe presque infime," etc.

(3) For the dates of Adelard's life and writings see C. H. Haskins in the *English Historical Review*, vol. xxvi., p. 491, and vol. xxviii., p. 515 (July, 1911, and July, 1913).

(4) Adelard elsewhere in the treatise explains that the earth, air, fire, and water which we see and feel are not the elements earth, air, fire, and water, but compounds.

(5) The following is the complete Latin text of the chapter. I have used both the printed edition in the British Museum, where the text is sometimes faulty, and the twelfth-century manuscript in the Eton College Library, which is possibly the autograph. The chapter heading reads, "Quare ex vase pleno inferius aperto aqua non exeat nisi prius superius foramen aperiatur." The text then begins :—

"Adhuc mihi de aquarum naturis quiddam dubitabile restat. Cum enim tempore ut scis iam preterito anum prestigiosam studio incantationis discende addissemus ibique anilibus imbuti sententiis nescio an sentibus aliquot diebus moraremur, eadem in domo vas quoddam mirabilis efficacie ad horas prandiles afferebatur. Quippe cum idem et superius et inferius perforatum multipliciter foret, aqua etiam ad manus abluendas infusa, dum minister aquarius superiora foramina pollice obturabat, nichil aque ab inferioribus emanabat, ablato a superiore pollice statim nobis circumstantibus per inferiora foramina aqua redundabat. Quod ego, ipsum prestigium esse putans, quid mirum, inquam, si anus dominica incantatrix est cum aquarius servulus monstra pretendat. Tu vero more tuo, quoniam incantationibus studiosus eras, minime illi rei vacare dignatus es. Nunc igitur quid de aqua illa sentis aperta; semper erant subteriora foramina et nichil tamen nisi ad aquarii arbitrium fluebat.

(A) Si prestigium id erat, nature potius quam aquarum violentia id incantatum est. Cum enim huius mundi sensilis corpus quatuor elimenta componant, ita ipsa naturali amore conserta sunt ut, cum nullum eorum sine alio existere velit, nullus locus ab eis tum vacuus sit tum esse possit. Unde fit ut, quamcito illorum unum a loco suo cedat, aliud absque intervallo eidem succedat, neque potest a loco cedere, nisi aliud quod substantiali quodam affectat amore possit ei succedere. Clauso igitur introitu succedentis frustra patebit exitus succurrentis, hoc itaque amore hac expectatione in cassum aquae reperies, nisi introitum aeri prestes. Haec enim, ut supradictum est, cum non pura sint, ita coniuncta sunt ut sine se esse non possint vel nolent. Unde fit ut, si in vase superius penitus integro inferius fiat apertio, non nisi cum intervallo quodam et quasi cum murmure liquoris fiat effusio. Tantus enim aer intercedit quantum inde liquoris exit, qui quidam cum ipsam aquam porosam inveniat innativa sibi et tenuitate et levitate penetrando superiorem vasis locum qui vacuus videtur occupat.

LYNN THORNDIKE.

The Economic Status of the Blackcap.

IN NATURE of January 7 Mr. W. E. Collinge (for whose work I have the greatest respect) places the blackcap in his list of injurious birds. As at once a gardener and an observer of birds for about sixty years I wish to protest against this accusation, which, if acted upon by fruit farmers, would soon lead to the extinction of the most charming songster of all the true warblers.

I grant that it eats small fruits, especially raspberries, but I contend that the insects it destroys must, from the economic point of view, fully counterbalance these depredations. This, of course, cannot be proved, because all the insects it devours are not injurious, and the proportion of these will vary in each locality, but considering that the blackcap arrives in this country early in April and does not leave until September, while the season for small fruits lasts practically only from the beginning of July to the middle of August, we have about sixteen weeks when it has to live on insects to six weeks of fruit eating!

Mr. Collinge rightly says that the bird is "not plentiful" (p. 510), but adds that it has considerably increased in numbers during the last eight or nine years (p. 511). To this I must entirely demur—certainly as regards this part of Kent, where much small fruit is grown. It is a bird the clear melodious song of which cannot be overlooked, and as I have been on the look out for it every spring for the last thirty years at least, I am perhaps as competent to form an opinion on this point as Mr. Collinge. I have never more than one pair in my garden, and rarely hear the bird elsewhere. I should say it is not as abundant here now as it was twenty years ago at Colwyn Bay, where I then lived.

ALFRED O. WALKER.

Ulcombe Place, Maidstone, Kent, January 26.

I REGRET quite as much as Mr. Alfred O. Walker to have to condemn the blackcap, but in an investigation of this kind one must always be careful not to allow sentiment or preconceived notions to bias one's opinion.

I have ample evidence that this bird has increased in numbers, at least in the midland counties, during the past six or seven years. I cannot speak for Kent. As to the nature of its food, an examination of the stomach contents of thirty-three adult and four nestling birds showed that the bulk of the food consisted of fruit and peas; there were a few aphids, twenty small lepidopterous larvæ, and the remains of seven beetles. Out-of-door observations made during the past ten years add still further evidence of the injuries these birds will inflict upon wall fruit, currants, strawberries, blackberries, raspberries, peas, etc. During the summer of 1913 I had ample proof in my own garden of the havoc four or five birds can commit on peas.

Mr. F. Smith, of Maidstone, a large fruit-grower and a careful observer, stated in a paper published in 1906 :—"A family of blackcaps in a cherry orchard commit grave havoc. They do not eat a quarter of the fruit they pick, and they are also very fond of raspberries and figs. It is the worst summer bird we have in the fruit plantations." This opinion has been confirmed by fruit-growers in all parts of the country.

Where this species is not plentiful or in non-fruit-growing districts, it may be left alone, but in fruit-growing districts it should not be allowed to increase, further, as I stated in 1913, "any attempt at protection will justify fruit-growers in taking vigorous measures for extermination."

WALTER E. COLLINGE.

8 Newhall Street, Birmingham.

Names in Mechanics.

IN the current number of NATURE Sir Oliver Lodge refers to the usefulness of naming units, and many of us remember what a clearing up of ideas resulted in the student's mind from the substitution of the term "radian" for the circumlocution "unit of circular measure." I wish to ascertain any names that have been proposed for units in mechanics, and have attained little or no vogue; as instances "velo" and "celo" may be mentioned, which were proposed as names for the units of velocity and acceleration. I wish also to know how far Prof. Perry's "slug" is in use. Can any reader of NATURE help me?

DAVID MAIR.

NOTES ON STELLAR CLASSIFICATION.

II.

IN the first series of notes[1] I stated how I was trying to find whether a combination of the meteoritic hypothesis and my system of *chemical* classification of stars into two series of ascending and descending temperatures might land us in a method of detecting *physical* differences. The importance of this inquiry depends upon the fact that any system of *chemical* classification along one line must land us in confusion, seeing that equal or nearly equal temperatures, and therefore chemistry—for chemistry is the child of temperature—mark two very different physical states in the life of a star in its progress from nebula to extinction as a cold solid globe.

In order to show the method of attack I give here a diagram showing my classification and that of Harvard (H.3) based upon chemistry. The Harvard symbols given are those of the type stars used in my classification, but the letters B, F, K, etc., are generally used alone.

The difference in physical state assumed on the meteoritic hypothesis is indicated by the wide dotted curve to represent nebulous conditions at the bottom of the ascending arm, and the firm dark line to represent condensed stars at the bottom of the descending one.

I first deal with the evidence of bright lines in certain chemically classified stars as constituting a difference from the normal stars in which bright lines do not occur. The inquiry will show us the stellar species in which these bright lines occur.

In 1876 I suggested that bright lines in stellar spectra might be added to a dark line spectrum by our spectroscopes revealing to us the presence of a gaseous envelope above the most valid absorbing region.[2] I believe Pickering was the first to see such an envelope, and it has been seen since by others.

How such an envelope can strengthen its story when its temperature is increased is shown in a valuable table given in Miss Cannon's catalogue.[3] There we find eighteen stars in which bright Hβ alone is superposed on the absorption line in eight stars. In the others Hγ is added in ten cases. In six stars we get Hδ added to Hβ and Hγ. In one star we get a fourth line, Hϵ, added to the preceding three. As lines are added the intensity of the earlier lines is increased. The extreme case is μ Centauri, where the intensity of the hydrogen lines is ϵ 2, δ 3, γ 6, and β 10. In some cases the bright lines are variable, but the same law holds; the work always begins at the red and decreases towards the violet (Fig. 2).

But this is not all the story. In μ Centauri, where we get the greatest development of the bright hydrogen, there are other lines. All these lines but one are enhanced lines—and of iron!

Among the facts to be borne in mind in considering these questions are those revealed by the recent study of the Madrid photographs of the recent Nova (Geminorum 2), recorded in the last volume of Kensington researches.

The photographs showed a well-marked stage as the Nova cooled down, principally indicated by a bright line near λ 4640 (4639·2); and it was further noted that in previous Novæ the appearance of this line preceded that of the ordinary nebula line near λ 500, and further that it was the brightest line in the whole spectrum where Hβ, Hγ, and λ 4472 were visible.

The 4640 line has been noted in several planetary nebulæ, and among the bright lines of the Wolf-Rayet stars not yet chemically classified.

This line is associated in Novæ and elsewhere with another at λ 4688, not produced by the same substance for the lines vary inversely; it also is frequently seen in the Wolf-Rayet stars.

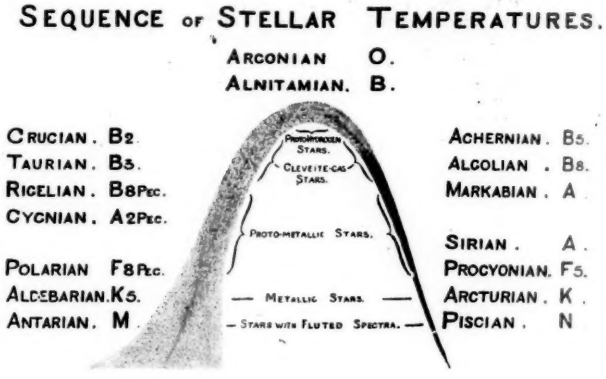


FIG. 1.—The temperature curve.

We seem justified, then, in assuming, to begin with at least, four stages of bright lines:—

H + enhanced lines
H + 4688
H + 4640
lowest temperature H + 500.

and these are common to the stellar envelopes and novæ.

If we include P Cygni, we find another change,

highest temperature H + He + lines of O + N.

Of the substance which produces 4640 we know as yet nothing, but it is possible that 4688 represents carbon, of the existence of which in nebulæ and the Wolf-Rayet stars there is evidence.[4]

On the other hand, in 1905[5] Mr. Baxandall and myself recorded a line at λ 4685·97 in the spectrum of a helium tube, and its occurrence in stars was noted. This would be another origin,

[1] NATURE, November 12, 1914.
[2] See Proc. Roy. Soc., 1878, p. 49.
[3] Harvard Annals, vol. xxviii., part ii., p. 228.
[4] See especially my paper in Proc. R.S., vol. xlvii., p. 40, 1889.
[5] Proc. Roy. Soc., vol. lxxiv., p. 546.

proto-helium. A further inquiry on this subject is necessary, and is under way.

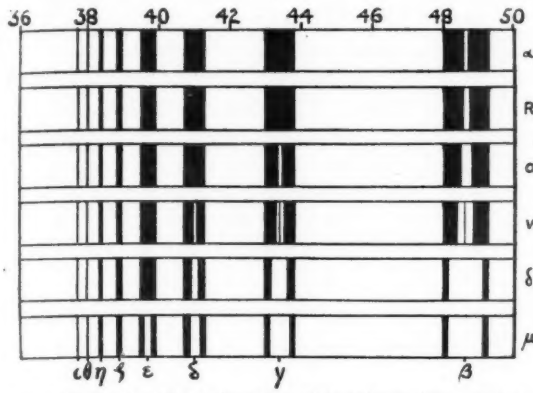


FIG. 2.—Showing how bright hydrogen lines of the stellar envelope make their appearance superposed in the dark absorption lines produced by the subjacent atmosphere or photosphere. This also occurs from the least refrangible side, extending to the blue end as the intensity increases.

It is clear from the above that bright lines have a way of their own, and that the absorption lines and the bright lines have to be studied separately.

It must also be stated that in the majority of non-variable stars with bright lines, the absorption lines have not yet been sufficiently studied to allow of their chemical classification.

I next come to a different origin of bright lines studied in some variable stars. The variability of these is due to a brightening of the continuous spectrum and *the appearance of bright radiations*, at maximum. I have previously (Bull. I.) referred to my hypothesis that these are produced by collisions between meteor swarms.

The simplest case is represented by a swarm B (Fig. 3) revolving round A and colliding at periastron. The light curve of the variability thus produced is represented in the middle part of

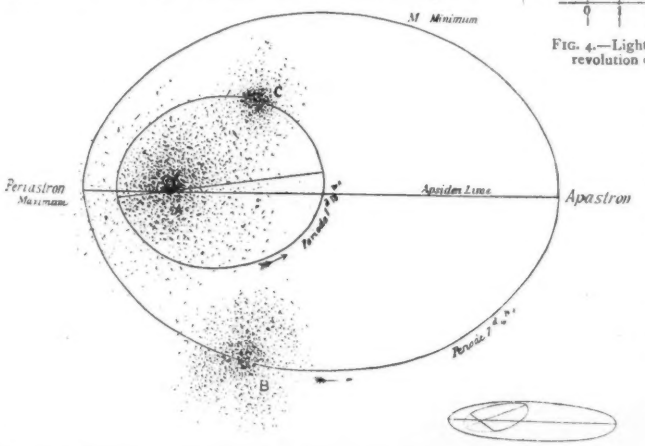


FIG. 3.—Orbits of two meteor swarms B and C round their primary A, colliding at periastron.

Fig. 4, a rapid ascent followed by a slower descent, and the curve is smooth.

The illustrations are taken from Dr. Lockyer's memoir on the variability of η Aquilæ.

In a less simple case, there is a third swarm, C, involved, with a much shorter period than that of B. The combined curve is no longer smooth.

What, then, is the actual physical condition of these two sets of stars with bright lines? In order to answer this question and to test the collision theory in the case of the variables, we must know whether their temperature is rising or falling.

A set of diagrams has been prepared by Mr. N. K. Johnson showing the Harvard and Kensington classifications, the former, except at the bottom, common to the two arms of the temperature curve, which is indicated by two vertical lines and a connecting horizontal line at the top.[6]

To use these we may begin by taking the case of the constant bright line

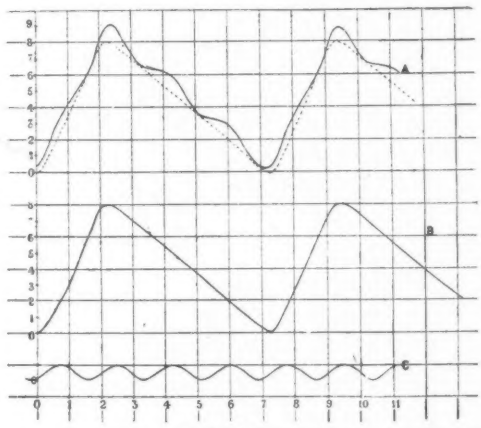


FIG. 4.—Light curves. B, produced by revolution of B; C, produced by revolution of C; A, compound carve produced by both revolutions.

stars, omitting the Wolf-Rayet stars. Of the thirty-eight stars given in the revised Harvard photometry, twelve, indicated by crosses, are included in my classification. All these are near the top of the temperature curve. There is a fair assumption then that the other twenty-six stars may follow suit—that is, that they probably belong to the species which include the twelve; in the absence of a complete classification, therefore, inquiries involving their physical state will be safer in accepting this assumption than in neglecting it.

NORMAN LOCKYER.

[6] The original temperature curve contained gaps below the Cygnian and above the Sirian types for two other possible classes, but these are omitted in the diagrams.

TRINITROTOLUENE IN THE WAR.

IN a recent article in NATURE (December 24, 1914), brief reference was made to the high explosives used as bursting charges for shells, the most important being the much-discussed trinitrotoluene, used largely by the Germans. The following summary of an able contribution on the subject, published in the *St. Thomas's Hospital Gazette* for December, will prove a useful supplement to the previous article in our columns.

Few people realise the exacting conditions which a high explosive for shells must fulfil; these may be summarised as high bursting power, stability in storage, insensitiveness to shock on firing from the gun and on impact of the projectile, where it is desired that penetration shall precede bursting. Yet it must be possible to cause the material which withstands such drastic treatment to detonate when required with frightful violence. It is a case of reconciling the irreconcilable. Further points are safety in handling in the shell factory and the suitability for producing maximum density of loading, say by some such method as melting and pouring into the shell.

The brisance, or bursting power, is shown to depend on the potential energy of the explosive, the velocity of detonation, and the degree of concentration (density of loading).

It will be realised that few substances will fulfil such conditions, and the number will be still further reduced by difficulties and cost of manufacture. The paper discusses the four most important explosives which have been tried for this purpose, namely, picric acid (lyddite), trinitrotoluene (TNT), tetranitromethylaniline (tetryl), and tetranitraniline.

The trinitrotoluene is the symmetrical isomer (1 : 2 : 4 : 6) melting at 80·6. It is manufactured by dissolving *ortho*nitrotoluene in concentrated sulphuric acid, nitrating first to the dinitro and finally to the trinitro stage, the purification being effected by recrystallisation from ethyl alcohol containing a little benzene.

Data are given of comparative trials of TNT and picric acid, both in France and Germany. In velocity of detonation and with the lead block test (increase in size of cavity on firing a charge) the advantage is with lyddite, as the following figures demonstrate :—

	Lyddite	TNT
Velocity of detonation	7745	7140 metres per sec.
Lead block test	228	218 c.c.

TNT caused, however, a greater displacement of earth than lyddite when fired in a bore-hole 1 metre deep.

Except in the last instance, picric acid held a decided advantage throughout, and the question at once arises: Why, then, has trinitrotoluol been adopted by Germany, Russia, Italy, and other countries in preference to the picric acid that is still mainly used by us under the name of lyddite, and by France under the name of melinite? The struggle between the two explosives has been long and of doubtful issue, but it has now probably ended in the victory of trinitrotoluol.

In furnishing the answer to this conundrum the writer continues :—

We have seen it to be inferior in regard to power, velocity of detonation, and density of concentration; its advantages lie in its greater insensitiveness to shock, its freedom from poisonous dust and fumes, the much lower temperature at which it can be poured into shells, and its chemical indifference to substances like lead and iron which are liable to form dangerous picrates. When firing a shell against a ship's armour, at certain limits of the thickness and toughness of the armour-plate and of the velocity of the shell's impact, picric acid would explode when trinitrotoluol would perform its work efficiently, and the latter is therefore better adapted to a high-velocity shell of large calibre.

Since TNT contains too small a percentage of oxygen for complete combustion, attempts to use it incorporated with bodies rich in oxygen, such as potassium chlorate, have been tried. The Belgian high explosive, "macarite," is stated to consist of 30 parts of TNT and 70 parts of lead nitrate. A very high density of loading is thus attained, but the velocity of detonation of macarite is given as only some 4600 metres a second.

In concluding his article, the author says that tetranitraniline or tetryl seem to be the only known substances that may supersede trinitrotoluol.

TYPHOID IN THE FIELD.

THE anti-vivisectionists, by their raging attack on the protective treatment against typhoid fever, have shown us, once more, the dark and ugly side of anti-vivisection. Kind people may try, but may try in vain, to find any excuse for such goings-on. The only possible sort of excuse for them is, that the treatment is not perfect, not faultless; and that, among some hundreds of thousands of men and women who have received it, a few—perhaps one in a thousand—have not done well. One in a thousand is a fair guess, founded on the experience of the 20,000 Valcartier men of the Canadian forces: but Surgeon-General Williams, Director of Medical Services, Australian Imperial Force, says of the protective treatment of 20,000 Australian troops, "Not one single case showed any after-symptom which could be considered worthy of consideration. . . . Not a man had to be taken off duty; drills and exercises proceeded as usual" (*Times*, January 30). Further, we may admit that the overwhelming rush of work, at the beginning of the war, may have caused, here or there, some error of judgment, or some neglect of this or that bit of technique. The strain on the Army Medical Department, the incessant overwork, were well-nigh intolerable; and it is more than likely that some men got the treatment without any precise directions how to take care of themselves after it, or even without much chance of taking care of themselves. If a man, for a couple of days after the treatment, will avoid over-exertion, and alcohol, and exposure to the danger of pneumonia, he may be confident that he will do

well, and will have very little trouble from the treatment.

To admit this much is not to excuse the anti-vivisectionists; indeed, it makes their behaviour look blacker than ever. For example, they discover a case of pneumonia, coming on after the treatment, and forthwith they proclaim it as "septic pneumonia from inoculation." Or they discover a case of a bad arm after ordinary vaccination; this may have been the man's own fault; later he was discharged from the Army for a cause which had nothing to do with his arm. And forthwith they declare that the man's health was so impaired by the protective treatment against typhoid that he had to leave the Army. "Proved to be useless and dangerous"—that is the opinion—if we can call it an opinion—of these people. They are a very small handful of people, in proportion to the general public; but they are trying hard to prevent our men from being protected.

It is probable that some of them are incapable of clear thought on the subject. We may wonder what they will make of the statement just issued from the War Office, and published in Sir Frederick Treves's letter in the *Times* of January 26. Up to date, among our men abroad there have been thirty-five deaths from typhoid. Of these thirty-five men, thirty-four were not protected; it was two years or more since they had received any sort of protective treatment. Among our protected men there has been only one death, and this patient had only had a single dose of the protective treatment, instead of two doses as directed.

What will the anti-vivisectionists say to this? Which way will they look? Will they say that we do not know the proportion of non-protected to protected men throughout the Expeditionary Force? But we do know what strenuous and incessant efforts are made to avoid the sending out of non-protected men. Surely it is a safe guess that the great majority of the Expeditionary Force are protected. Nature leaves these alone; she picks out the non-protected. Two men shall be sleeping in one tent, fighting in one trench; the one shall be taken, and the other left. The anti-vivisectionists know that, lots of them; and we come back to Newman's saying, "Perhaps it is wrong to compare sin with sin, but I declare to you, the more I think of it, the more intimately does this *Prejudice* seem to me to corrupt the soul, even beyond those sins which are commonly called most deadly."

MR. F. W. RUDLER.

AS announced with regret last week, Mr. F. W. Rudler died on January 23 at his residence, Tatsfield, Surrey, after a brief illness, in his 75th year. He will be lamented by a large number of scientific friends, who have known him not only as the genial curator of the Museum of Practical Geology, but also as a prominent member of many scientific societies and at the meetings of the British Association.

It was some fifty-five years ago that Mr. Rudler was appointed Assistant Curator of the Jermyn Street Museum. He rapidly made his mark as a mineralogist, and became more and more in request as a specialist in that department. In 1876 he was appointed lecturer in natural science at the University College of Wales at Aberystwyth; but in 1879 was recalled to succeed Mr. Trenham Reeks, as Registrar of the Royal School of Mines and Curator of the Museum of Practical Geology, which post he held until his retirement in 1902, when the high appreciation of his services was marked by the bestowal upon him, by King Edward, of the Imperial Service Order.

Beyond his official duties, Mr. Rudler was a busy worker and a voluminous writer. He was at different times president of the Anthropological Institute, also of the Geologists' Association and of the Essex Field Club. He was for years an active member of council of the Geological Society, and was awarded the Lyell Medal of the Society in 1903.

Mr. Rudler's popularity as a science lecturer caused him to be much sought after. His writings were largely in connection with technical works, such as "Ure's Dictionary of Arts and Manufactures," "Thorpe's Dictionary of Applied Chemistry," "Muir's Dictionary of Chemistry," the "Encyclopædia Britannica," etc. Articles and reviews flowed from his pen in a continuous stream for years, and he will long be remembered as a man of wide scientific attainments and high literary ability.

NOTES.

THE committee of users of dyes appointed to confer with the Board of Trade as to a national dye scheme has come to a unanimous decision in favour of the adoption of a scheme which differs in certain important respects from those of the scheme previously made public. The proposal is to form a company with an initial share capital of 2,000,000*l.*, of which 1,000,000*l.* will be issued in the first instance. The Government will make to the company a loan for twenty-five years corresponding to the amount of share capital subscribed up to a total of 1,000,000*l.*, and a smaller proportion beyond that total. The Government advance will bear interest at 4 per cent. per annum, payable only out of net profits, the interest to be cumulative only after the first five years. In addition, and with the desire of promoting research, the Government has undertaken for a period of ten years to make a grant to the company for the purposes of experimental and laboratory work up to an amount not exceeding in the aggregate 100,000*l.* The modified scheme has been received with more approval from users of dyes in Leeds and the district than the original scheme, and the feeling appears to be general that it will meet with a considerable measure of success. The grant for scientific research in connection with the manufacture of dyes is a particularly satisfactory provision of the new scheme.

THE relation between science and industry in this country has been the subject of a number of letters and articles in the daily papers recently, but the real difficulties of the situation from the scientific point of view have not usually been explained. Prof. J. F. Thorpe, however, in the *Times* of February 2, states clearly what the national needs are in this matter. It is often supposed that when business men decide what substance they wish to obtain all the chemist has to do is to look up the details of the preparation of the substance in the German patent literature and then to proceed in the same manner as a chef would do if he wished to make some new kind of pudding. This point of view is due to an entire lack of understanding on the part of the non-scientific person of the principles underlying scientific processes. Essential details are carefully excluded from patent specifications, and it is safe to say that an independent worker would, in most cases, have to devote some months to experiments on the scientific scale before he could find the correct conditions for applying a process to the commercial scale. Prof. Thorpe pertinently remarks in concluding his letter:—"Do the Government imagine, therefore, that any works research laboratory is going to solve these problems and adapt them to commercial conditions within any reasonable period of time? If they do, they are greatly mistaken. The object *can* be achieved, but only by enlisting the services of every trained organic chemist in this country. The Government must organise the knowledge and skill which is, from the industrial point of view, now wasting in our universities, university colleges, and technical schools; moreover, it is only by a scheme such as this that the nation will be able to pick out those men who are fitted by temperament to be directors of commercial processes."

IT is a fine instance of taking things quietly that the Rev. W. M. L. Evans, rector of Saxby, in North Lancashire, should write to the *Times* of January 28 pointing out that the pheasants of the parish were very much excited on the morning of Sunday, January 24, when the naval engagement was in progress. From the way in which the pheasants were "all over the place with their fuss," the clerk of Saxby inferred "there be rare goings on in the North Sea the morn." Without precise records of hours, observations of this sort are not of much scientific value, but they suggest that those who have time and are familiar with the normal ways of birds should keep an eye on similar occurrences. It is well known that birds have a quick and discriminating sense of hearing, and there is nothing essentially improbable in supposing that the Saxby pheasants heard news which failed to reach the parishioners. Several correspondents describe in the *Times* of February 1 observations in support of Mr. Evans's account of the disturbance of pheasants by the North Sea cannonade; and instances are given of similar effects produced on the birds upon other occasions and in other places, including New Zealand, by distant explosions and earthquakes. It may be premature to believe in the extraordinary sensitiveness of the Saxby pheasants, and the case is not strengthened by a reference to the geese of the capitol, but critical and comparative observations on the sense of hearing in birds would be interesting. It is certain, said Bewick, "that nothing can stir in the night, nor the least or most distant noise be made, but the geese are roused, and immediately begin to hold their cackling converse." It should also be remembered that noises inaudible in one zone are sometimes perceived in another more distant.

IN *Popular Astronomy* Prof. E. C. Pickering quotes some interesting letters from Profs. Backlund, of Pulkovo, and Schwarzschild, of Potsdam, with reference to astronomers and the war. None of the Pulkovo astronomers have been called to serve, but Prof. Backlund's son is in the Russian ranks, and of French astronomers, M. Croze, astrophysicist of the Paris Observatory, has been summoned, as well as the son of the director, M. Baillaud, who has six sons and sons-in-law in the war. On the German side, many young astronomers are in the field. Dr. Zurhellen and Dr. Kühl, who were with the eclipse expedition, have been interned in Russia; Dr. Münch, of Potsdam, is wounded and a prisoner in France. Prof. Schwarzschild writes that he is himself at Namur, conducting a military meteorological station in the interest of the German aeroplanes and dirigibles. Prof. Bauschinger, director of the Strasburg Observatory, is a temporary terminus commander in that city. The *Astronomische Nachrichten* contains announcements of the deaths in the ranks of Dr. J. Liebmann, astronomer at the Berlin Observatory; also of Dr. Adam Massinger, of the Heidelberg Observatory, his death cutting short an elaborate investigation of the nebulæ photographed at the observatory. Dr. Martin Matzdorff, assistant at the Strasburg Observatory, a young man of great promise, was killed at Ypres in November.

DOUBTLESS further particulars will be available when the American mail brings over last week's technical papers, but in the meantime it is probable that the long-distance telephone record, namely, conversations between Washington and San Francisco, both *via* New York and Boston, is no more than the natural outcome of the gradual extension of telephone lines with "loading coils" on the Heaviside-Pupin principle. That the feat has been accomplished by means of a new device just invented by Prof. Pupin, as one might gather from the telegram sent by the New York correspondent of the *Times* last week, seems unlikely. The "loaded" telephone line from New York to Denver (a distance of 2000 miles) has been in use for some little time, and the extension of this to San Francisco (making a distance of 3000 miles) is known to have been under construction. Apparently, as an experiment, a considerable *détour* was made, no doubt over other "loaded" lines, and Jekyll Island (Georgia) was included in the circuit; the total distance telephoned over is given as 5000 miles—certainly a record. It is interesting to note that Prof. Graham Bell, the inventor of the telephone, and now more than eighty years old, was able to converse over the line. The *Times* correspondent regards the event as foreshadowing the day when New York can talk with London,

but this is somewhat premature. Although this distance is far less than 5000 miles, yet the problem is a much harder one owing to the enormously greater electrostatic capacity of a cable as compared with a land-line. There is much in Prof. Fleming's prediction that telephony between England and America, when it comes, will first be by "wireless."

SOME anxiety has been felt as to the fate of M. le Chanoine Henri de Dorlodot, Professor of Geology at the University of Louvain, concerning whom his colleagues in this country had been unable to obtain information. They will be glad to learn that he is at Louvain, in excellent health, and that his house and museums are absolutely untouched.

A PUBLIC lecture on the present position of the atomic theory was delivered by Prof. J. W. Nicholson at King's College on January 21. The lecturer reviewed the work of Faraday on electrolytic conduction, the origin of our first perception of the ultimate charge *e*, and proceeded to a historical sketch of the evolution of modern ideas of the atom as a purely electrical structure. An account was then given of very modern work in connection with radio-activity, X-rays, and emission spectra, concluding with the probable structure and number of electrons present in atoms of the simpler elements, and the possibilities of a celestial evolution of the elements which are now disintegrating.

SINCE January 14 several earthquakes have been felt in Italy and elsewhere. Two after-shocks of the Avezzano earthquake were felt in Rome on January 18. During the night of January 18–19, three earthquakes occurred in the province of Cosenza (Calabria), some buildings in the village of Luzzi being slightly damaged. According to the *Times*, various observatories in Italy recorded an earthquake at 2.15 a.m. (1.15 a.m., G.M.T.) on January 27, which lasted ten minutes, and was more violent than that which destroyed Avezzano. As no further account has been published, this earthquake would appear to be the same as that registered in British observatories at about the same time. The West Bromwich seismogram suggests an origin distant about 1500 miles, probably in Turkey or Greece.

IN the issue of NATURE for July 10, 1913, (vol. xci., p. 483) particulars were given of the allocation by the Mansion House Committee of the Captain Scott Fund. It will be remembered that the allocation fell under three main headings: the provision for relatives, for the publication of the scientific results, and for memorials. In connection with the last-mentioned object it is now announced that the committee has entrusted the execution of a monument to Mr. Albert H. Hodge. The monument and the pedestal are to cost 7500*l*. The architectural portion is to be of grey granite. A site has been selected by the committee facing the Thames in the grounds of Greenwich Hospital. A bronze memorial tablet to be placed in St. Paul's Cathedral is being executed by Mr. S. Nicholson Babb.

THE director of the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C., has kindly sent us further information upon the subject of the trade in birds' feathers between India and Germany, referred to in a note in NATURE of January 28 (p. 596). He reminds us that the "Report from the Select Committee of the House of Lords on the Importation of Plumage Prohibition Bill (H.L.) 1908," contains much information of interest upon the subject. The Select Committee reported that "it appears clearly from the evidence that the enactments of British Colonies and certain foreign countries, which provide a close season for wild birds, and of India, which prohibits their export, are to a considerable extent ineffective, partly on account of the open market in this and other countries. Mr. Todhunter, who attended on behalf of the India Office, showed the difficulties of preventing illicit exportation." The Report may be purchased, either directly or through any bookseller, from Messrs. Wyman and Sons, Ltd., Fetter Lane, London, E.C., the reference number being H.L. 137, and the price 6*d*. (ex-postage), or it may be consulted at the office of the Commercial Intelligence Branch of the Board of Trade.

IN the *Cairo Scientific Journal* for August, 1914, Mr. W. H. Harding King has collected a good budget of folk beliefs and songs from the western oases. The magical element is prominent in the beliefs of these people. When a child is born grain and salt are trundled about in a sieve to ensure the child against want; the pestle and mortar are beaten to make sure that he may not be frightened by any noise when he grows up; seeds are thrown about in the village as a charm to enable him to travel to any part of the world that he pleases, and the sieve is rolled about so that when he grows up he may run about quickly. When his finger nails grow long they are cut, and the ends of his fingers are dipped into newly ground flour to prevent them from growing again, and as the natives consider it unlucky to open a pair of scissors before the child's face, his nails are either cut behind his back, or bitten off by his parents. To protect trees from the Evil Eye and to ensure a good crop, a bone or the skull of an animal, or a piece of manure or a small doll-like figure are hung on the branches. Natives refresh themselves by stuffing the small pungent onions of the oases into their nostrils; onions which over night have been kept under the pillow are hung with the barley to bring refreshment to the family until the next season.

THE Herbert Spencer Lecture at Oxford last year was delivered on November 18, 1914, by the Hon. Bertrand Russell, on "Scientific Method in Philosophy," and has just been issued in pamphlet form by the Clarendon Press (1*s*. 6*d*. net). Mr. Russell's thesis is that it is from science rather than from ethics or religion that philosophy should draw its inspiration. In fact, scientific philosophy aims only at understanding the world and not directly at any other improvement of human life; and thus it cannot take account of ethical notions without being turned aside from that submission to fact which is the essence of the scientific temper. It is piecemeal and tentative like other sciences, and not like philosophy has been hitherto, where each philosopher had to

begin the work again from the beginning. For further elaboration of the views on logic as the essence of philosophy and the foundations of physics, Mr. Russell refers to his book on "Our Knowledge of the External World" (Chicago and London: Open Court Publishing Co., 1914); reviewed in NATURE of November 12, 1914 (vol. xciv., p. 278). The adoption of scientific method in philosophy compels us to abandon the hope of solving many of the more ambitious and humanly interesting problems of traditional philosophy; but what it does solve it solves with great precision.

IN the *Revue Scientifique*, No. 1, 1915, an interesting summary is given by Dr. Landrieu of the use of tincture of iodine for the antiseptic treatment of wounds on the battlefield. Descriptions are given of several ingenious tubes by means of which the iodine may be carried and applied. Dr. Maumus, in the same journal, also gives an account of tetanus among the wounded.

WE have received the annual report of Livingstone College for 1913–14. This was the last session of the principalship of Dr. Harford, who has worked untiringly for twenty-one years. During this period 548 students have passed through the college, and have gone forth to all parts of the world. The college was instituted in order to give some medical education to missionaries, and it has well fulfilled its object. Mr. Loftus Wigram is the new principal.

WE have received as an excerpt from vol. iv. of the "Scientific Results of the Scottish National Antarctic Expedition" a report on the *Scotia* collection of Atlantic fishes by Mr. R. S. Clark. The fishes were collected between 40° N. and 36° S., near Azores, Madeira, Cape Verde Islands, Ascension, St. Helena, Cape Colony, St. Paul's Rocks, and their main interest is in increasing our knowledge of the geographical distribution of some species, *e.g.* at St. Helena. No new forms were found.

IN the January number of the Transactions of the Herts Natural History Society, Mr. J. Hopkinson gives a summary of the climate of Hertfordshire, based on general observations for twenty-five, and rainfall records for seventy, years. February, March, and April are the driest, and the months from July to November the wettest, October attaining the maximum in the latter respect. The minimum rainfall in any year at any one station during the period under review was 15·79, and the maximum 42·56 in.

BOTH the January and February numbers of *My Children's Magazine*, edited by Mr. Mee, contain admirable and well-illustrated natural history articles specially suited to juvenile readers. The subject in the January issue relates to insects serviceable to man; particular attention being directed to the collection and preparation of silk-cocoons in Syria. Reference is also made to a scarcity of flowers in the south of England, owing to the ravages of the bee-disease. The food-storing habits of various animals form the subject of the article in the February issue.

TO vol. xxv., part 2, of the Bulletin of the American Museum of Natural History, Dr. R. Broom contributes an illustrated catalogue of type and figured specimens of Permian, Triassic, and Jurassic South African reptiles in the collection, as an instalment of the catalogue of the whole series of typical and figured fossil vertebrates in the museum. The South African collection, which is a particularly fine one, was mainly brought together by Dr. Broom himself. The publication is dated January, 1915, but it unfortunately contains the description of a new genus and species (*Youngina gracilis*) which had already been named in the fourth part of the Zoological Society's Proceedings for 1914, published in December last.

SOME fundamental morphological objections to the mutation-theory of de Vries, by Prof. E. C. Jeffrey, and the English black-and-white rabbit in connection with the question of Mendelian unit-character constancy, by Messrs. W. E. Castle and P. B. Hadley, form the subjects of two out of the three chief articles in the January number of the *American Naturalist*. In the former it is asserted that *Oenothera lamarckiana*, and other species of the same genus, which form the main basis of the de Vriesian mutation hypothesis, are (like other members of the Onograceæ) much contaminated by natural hybridism. The species of Œnothera are thus largely, if not wholly, cryptohybrids; and Bateson's objection to the genetical purity of *Oe. lamarckiana* is confirmed and also shown to be applicable to other members of the group. As hybridism is the best explanation of the behaviour of these species in cultures, it follows that the de Vriesian hypothesis, "so far as it is supported by the case of *Oe. lamarckiana*, is invalid."

IN an article on eugenics and the war, in the January number of the *Eugenic Review*, Mr. Theodore Chambers emphasises the all-importance in warfare of supreme care and attention in the treatment of the sick and wounded. In the old days, at any rate, the vastly greater proportion of the deaths in war were due to sickness; and although matters have immensely improved in this respect, "it is necessary to urge that even to-day far too little attention is being given by the nations which consider themselves the most civilised in the world to this aspect of war." Later on he observes that "from a military point of view, a voluntary army is probably far more efficient for its numbers than a conscript one. . . . One willing fighter is worth six pressed men." It is added that as universal training without conscription would raise the general physique of the nation, and in war-time would vastly increase the number of recruits for voluntary service, it is probable "that the best combination from the military and eugenic standpoints would be universal training with voluntary service for war."

THE Yale Peruvian Expedition has added a further contribution to our knowledge of Peru in the publication of an account of the Liverworts, by Dr. A. W. Evans, in the Transactions of the Connecticut Academy of Arts and Sciences, vol. xviii., of April, 1914. Many of the species come from the High Andes

around Cuzco, and some from the forests of the eastern slopes. Of the thirty-one species collected, six were previously unknown. The paper contains good illustrations and useful notes on the geographical distribution of the several species, a small number of which are peculiar to the Andes.

A COMPREHENSIVE account of Sea Island cotton in the West Indies, recently issued by the Imperial Department of Agriculture as Pamphlet No. 74, forms a very trustworthy guide to those concerned in the West Indian cotton industry. The history of the industry is detailed, and chapters follow on the botany, cultivation, picking, and grading, examination of seed cotton and lint, insect pests, and diseases, etc. The pamphlet consists of 118 pages, and is very well illustrated, the general information has been selected with great care, and the compilers are to be congratulated on the preparation of so useful a manual.

THE story of the discovery of the fine cycad, *Encephalaitos Hildebrandtii* by Sir John Kirk, in Zanzibar and East Africa, and the transmission of specimens to Kew between the years 1868–78, forms an interesting contribution to Kew Bulletin No. 10, 1914. The story is told in extracts from Sir John Kirk's correspondence with Kew while he was acting as Consul-General at Zanzibar. Sir John's observations on the remarkable generation of heat in the male cones, made in 1878, are published for the first time; on one occasion a rise of temperature of as much as 16·5° F. was recorded.

THE compensation payable to tenant farmers for unexhausted manurial residues is mainly based on the tables drawn up by Hall and Voelcker with a view to their general application to stock of all kinds. It has been suggested by some valuers that special discrimination should be made in the case of pigs, on the grounds that the feeding of the pig differs greatly from that of other stock, and is largely restricted to the intensive feeding of young animals during the period of most rapid growth. In proportion to its weight the pig eats more dry matter and voids less dung than any other class of farm animal, so that a relatively high compensation value must be made for a relatively small weight of manure. In the current number of the *Journal of the Board of Agriculture*, Prof. Charles Crowther and Mr. A. G. Ruston describe an experiment designed to throw more light on this point. Two groups of pigs were confined in special pens, without litter, for periods of five days in each fortnight of the twenty-three weeks that the experiment lasted. All food consumed during the five days was weighed and sampled for analysis, but the excreta were collected only on the last three days of each period. There was a remarkably close agreement between the figures given by the two groups of animals, which showed an average weekly gain of 6¼ lb. per pig over the whole period of the experiment. The authors conclude that the manurial residues should not be credited with more than 25 per cent. of the nitrogen, 50 per cent. of the phosphoric acid, and 80 per cent. of the potash present in the foods. This means that the compensation allowance in the special case considered should be assessed at only three-fifths of that deduced from Hall and Voelcker's tables.

MR. E. H. CUNNINGHAM CRAIG, in a paper read before the Institution of Petroleum Technologists, has given a brief account of the prospective oilfields of Western Canada. This paper should be a welcome one as authoritative information upon the subject of these supposed oil regions is but scarce, although a number of wild rumours about one or other of them have been current for the last year or two. Unfortunately, Mr. Craig gives no very large amount of geological detail—probably there is not yet a great deal known definitely—but he shows that practically all the oil hitherto discovered in Western Canada comes from the Cretaceous formation, which is well, though irregularly, developed over a very large tract of country. He deals with three main areas, the Flathead and Pincher fields, the Calgary field, and the Vancouver area; the greater part of his paper is devoted to the second of these, which he appears to regard as decidedly promising, and he gives a full account of the wells that have so far yielded oil. Amongst these he describes the Discovery or Dingman well of the Calgary Petroleum Products Co., which has yielded an extraordinary water-clear oil, containing no less than 72 per cent. of benzine and capable of being used crude in the engine of a motor-car. It is evidently too early for any definite opinion to be pronounced as to the possibilities of Western Canada as a producer of petroleum, but Mr. Craig, who has studied the whole area very thoroughly, appears to be very hopeful as to its possibilities.

THE war and the weather during the first three months of the fighting is dealt with in the *Popular Science Monthly* for December by Prof R. deC. Ward, of Harvard University. The author points out the weather influence on war as one of the great controls to be reckoned with by every commander, and he likens the disregard of the weather factor to be about as serious as to forget to provide food, clothing, or ammunition. Some historical instances are given of the influence of weather on war. Mention is made of the weather controls being divided into two classes. In one the conditions are accidental, sudden, or unexpected, and in the other case the conditions are natural or normal, but not necessarily prepared for. The author says to know in advance the general climate of the war zone is very essential in planning a campaign or in organising a single engagement. From the nature of the despatches, he concludes that there was nothing in the meteorological conditions in August and in early September which had any noticeable effect upon the campaign. In mid-September constant reference was made to the difficulties caused by the heavy rains. The normal rains in September and October filled the trenches and often drove the troops out to fight with their bayonets, and the difficulty of moving heavy guns through the deep mud was a serious handicap to both armies, whilst the rivers were also flooded. The roads became quagmires, and in Galicia the soldiers were marching and camping in the snow. With the use of aeroplanes

and airships modern warfare has been rendered more than ever dependent on the weather.

The Central for December, 1914, states that 174 former students or members of the staff of the City and Guilds College, Exhibition Road, South Kensington, are now on active service. The positions held by some of these are mentioned in the nine pages devoted to old students and their doings, which always forms one of the most noticeable and, to most readers, welcome features of the magazine. A well-illustrated article of exceptional interest is that by Mr. A. C. Cookson describing the work which falls to the lot of the maintenance department of a railway.

PART I. of the new volume of the Proceedings of the Physical Society of London extends to 117 pages. The president, Sir J. J. Thomson, opens the volume with the account he gave at the Cambridge meeting of the society of his attempts to produce radiations to fill the gap of about eight octaves between the softest Röntgen radiation and the shortest ultra-violet rays. His address as president closes the issue. It deals with the production and nature of the ions in gases. At the present time the interaction between ions and molecules appears to be explainable either by Maxwell's inverse fifth power law or by the law of impacts of hard spheres. Two papers are devoted to electrical questions—Mr. D. Owen's on an alternating-current bridge method of determining inductance in terms of resistance and capacity; and Mr. A. F. Hallimond's on the voltage ampere curves given by a great number of point contacts when the voltage applied to the contacts is gradually raised. The only paper on heat is Mr. Barratt's on the heat conductivities of a number of glasses, woods, and other bad conductors. Two papers deal with general physics. Mr. B. W. Clack gives the final results of his work on the diffusivities of salts in dilute solutions, and Prof. E. P. Harrison traces the effect of temperature on Young's modulus for wires.

IN the *Revue générale des Sciences* (vol. xxv., p. 777) M. Louis Brunet discusses the position of the combatant nations as regards the power of obtaining supplies of the metals copper, zinc, lead, tin, nickel, and mercury, which play so important a part in modern warfare. The conclusion reached is that the position of the Franco-Anglo-Russian alliance is far better than that of the central European empires, not so much on account of the greater producing power of the alliance, but owing to its mastery of the sea, which has enabled the English and French fleets to prevent in large measure the importation of metals declared "contraband of war" from neutral countries into Germany and Austria.

THE *Times* Engineering Supplement of January 29 gives an interesting account of aeronautics in 1914. Among other notable achievements of the past year are the British record of 135 miles an hour, heights of five miles scaled, or closely approached, by both French and German machines, and flights in seventy miles-per-hour winds by fliers who do not pretend to be "star-pilots." No fewer than nineteen persons flew together in one huge aeroplane of Russian make in 1914. One of our own Army-built stable aeroplanes has climbed at the rate of 1700 ft. a minute—a rate of ascent four times as fast as an express lift in an American hotel. Eight months ago Dr. Glazebrook gave, before the Aeronautical Society, a *résumé* of the experiments which had achieved stability—experiments vouched for by Colonel Seely, who verified them by making uncontrolled flights in person without any previous practice. Though Bryan and Harper had published their mathematical work in 1911, and Lanchester three years before that, it was only these telling practical outcomes of their work that brought these authors into their own in England during the past year.

OUR ASTRONOMICAL COLUMN.

WOLF-RAYET STARS AND THE PLANETARY NEBULÆ.—There are indications that these enigmatic bodies will shortly be fitted into the scheme of stellar evolution. Hitherto, whilst it was felt that they must be more or less related, actual evidence was of the slenderest. Prof. J. W. Nicholson was, however, led by his mathematical investigations of the spectra of *nebulium* and Wolf-Rayet stars to suggest that they were successive stages in the evolution of matter. Perhaps we can now say that this is an observed fact. The *Astrophysical Journal* for December (1914) contains some remarkable preliminary results obtained by Mr. W. H. Wright in the course of the spectroscopic examination of some planetary nebulæ possessing central condensations. A spectrogram secured with the 36-inch refractor (Lick), under exceptionally close following during a long exposure on N.G.C. 6572, showed *the spectrum of the nucleus* crossed by the bright nebular lines of the envelopes, and, moreover, in the spectrum of the nucleus appeared a band 17 A. wide in place of the line λ 4686. These facts recalled the hitherto unique hydrogen envelope star of Campbell (BD + 30° 3639). Detailed study of the spectrum of this body was then undertaken and, as was expected, the fact was established that the hydrogen envelope really gave the spectrum of a planetary nebula.

Here, then, are two cases of planetary nebulæ having nuclei which exhibit the spectra of Wolf-Rayet stars and, together with three other cases (N.G.C. 6826, N.G.C. Index 418, and N.G.C. 40) cited from unpublished observations by Merrill, Campbell, and Paddock respectively, the facts are held to justify the conclusion that such nuclei are in *all cases* Wolf-Rayet stars. The evidence does *not* establish the converse proposition that Wolf-Rayet stars are in all cases the nuclei of planetary nebulæ The author promises a more detailed account of the observations and also the early publication of a list of nebular lines. The materialisation of these promises will be eagerly anticipated

THE SOLAR ROTATION IN 1913.—In the current number of the Journal of the Royal Astronomical Society of Canada (September-October, 1914) Mr. H. H. Plaskett gives an account of the results of a study of the solar rotation which he and Mr. R. E. De Lury secured during 1913. The method was spectroscopic, and the region of the spectrum examined was λ 5600; thirty-one plates were utilised, on each of which were recorded nine rotation spectra; in these spectra displacements were measured for twelve lines. Tables summarise the measures and the results. The results are compared with those obtained for the same region of the spectrum in the years 1911 and 1912 by Messrs.

J. S. Plaskett and R. E. De Lury, using the same apparatus. The 1911 and 1912 values are found to be considerably greater than those obtained in 1913. A measurement of the 1913 plates by Mr. J. S. Plaskett results in the same values as those secured by Mr. H. H. Plaskett. The communication suggests the possible origin of the discrepancies, and discusses them individually. The author finally concludes that there is no evidence of systematic difference of velocity for different elements, and that at present it is impossible to settle the question of a variation in the solar rotation or any similar problem until the personal errors of measurement of each observer have been determined. He gives the formula which represents the values of the solar rotation for 1913.

"L'ASTRONOMIE" FOR SEPTEMBER AND OCTOBER, 1914.—It is satisfactory to be able to state that in spite of the difficulties encountered at Paris in August and the following months of last year, the Bulletin of the French Astronomical Society, *L'Astronomie*, has not broken its continuity. The September and October numbers are now to hand, and those of November and December are completed, and will soon be issued. The September number continues the interesting series of articles on visits to the European observatories, that to the Zurich Observatory being here described and illustrated. Under the title "Jupiter" the observations made on that planet during the opposition of 1913 are described in some detail. Interesting curves are included, showing the displacement of the large red spot in longitude for a period of six months, and the variations of the duration of its rotation for the period 1830–1913. The chief contribution to the October number is a series of accounts of observations of the eclipse of the sun in August last, made from and outside of the line of totality. Some of these, notably that by the expedition from the Meudon Observatory, have already been referred to in these columns.

THE CANADIAN ASTRONOMICAL HANDBOOK.—"The Observer's Handbook for 1915," published by the Royal Astronomical Society of Canada, and edited by Dr. C. A. Chant, is in the seventh year of publication. The present issue is conspicuous by the absence of the brief review of astronomical progress, but this is probably more than neutralised by the addition of useful tables of double and variable stars, and an interesting table, compiled by Mr. W. E. Harper, giving some concise information regarding the brighter stars. The last-mentioned deals with 272 stars and five nebulæ, and gives the chief known facts concerning their distances, spectral types, proper motions, radial velocities, etc. In the section on the constellations charts are given containing the stars down to the fifth magnitude. Mr. W. F. Denning contributes the section devoted to meteors and shooting stars. The other sections are mainly on the lines of former issues.

COPPER SMELTING IN CANADA.

THE Canadian Department of Mines has issued an interesting report of some 184 pages, profusely illustrated, upon the copper smelting industries of Canada, from the pen of Dr. Alfred W. J. Wilson, Chief of the Metal Mines Division. This report forms a valuable record of the position of Canada as a copper producer at the date at which it was written, namely, the close of the year 1912. As the author very truly observes, "the period of time which necessarily elapses between the writing and the publication and distribution of Government reports is usually too long to make them an important medium for the distribution of new knowledge in an old and well-established industry," and indeed the present report well exemplifies the correctness of this view, there being nothing in it with which copper smelters throughout the world are not thoroughly familiar, its chief value lying accordingly in the fact that it furnishes a trustworthy "record of the status of the industry at the time it was prepared," which Dr. Wilson puts forward as the chief purpose for which it was written.

The work contains an introductory chapter, separate chapters dealing in detail with the works of the Canadian Copper Company, the Mond Nickel Company, Ltd., the Consolidated Mining and Smelting Company of Canada, Ltd., the Granby Consolidated Mining, Smelting, and Power Company, the British Columbia Copper Company, and the Tyee Copper Company, and final chapters of summaries and statistics. From these it appears that at the date mentioned there were in operation in Canada in the seven smelting works of the above six companies twenty-nine large rectangular water-jacket blast furnaces, with a total hearth area of 2580 sq. ft., and a rated capacity of 15,600 tons of charge per twenty-four hours; the largest of these is a 50 in. by 420 in. furnace of the Consolidated Mining and Smelting Company, with a rated capacity of 875 tons of charge per twenty-four hours, but there are no fewer than four of these furnaces with a smelting capacity of 700 tons or more per twenty-four hours, and only two with a capacity below 400 tons. The matte produced in these blast furnaces is blown in converter plants, of which there are five in all, two being operated by the Granby Consolidated Mining, Smelting, and Power Company, at their Grand Forks and Anyox Works respectively, and one each by the Canadian Copper, the Mond Nickel, and the British Columbia Companies. All but the last-named are basic lined, some using the horizontal cylindrical and some the vertical patterns.

The Canadian Copper Company produces a furnace matte with about 28 per cent. of copper-nickel, which is blown in the converters to rich matte, with 80 per cent. of copper-nickel; the Mond Nickel Company runs a furnace matte with 33 per cent. of copper-nickel, which is also blown up to 80 per cent. (38 per cent. copper, 42 per cent. nickel, 15 per cent. iron); these rich mattes are shipped for further treatment and refining. The Granby Consolidated Company was only operating the works at Grand Forks in 1912, the Anyox works not having been started as yet; they were producing furnace matte with 35 per cent. of copper, which was blown up to blister copper of good quality with 99·5 per cent. of copper, containing, in addition, gold and silver; the British Columbia Company smelted a furnace matte with 40 per cent. of copper, which was also blown up to blister copper. Both these companies shipped their blister copper to the United States for refining.

As to the two companies that do not operate converters, namely, the Consolidated Mining and Smelting Company at Trail, and the Tyee Company, the former runs a first furnace matte with 10 per cent. of copper, which is twice concentrated in the furnaces, the second matte containing 15 to 20 per cent. of copper, and the final matte 40 to 42 per cent. of copper; the Tyee Company runs largely on customs ores, and produces a final matte with 40 to 43 per cent. of copper; both these companies ship their mattes to the United States for further treatment. It thus appears that although Canada produced in the above year nearly 78 million pounds of copper, not one pound of this was converted into merchantable copper within the Dominion. The only reference to this fact to be found in the report before us is an

incidental statement by Dr. Wilson that "there are no copper refineries in Canada." It is difficult to understand why Canadian copper producers should be willing to forgo the very handsome profit realised by the refining of their crude products, and why they should be so ready to ship these products to the United States instead of completing the refining process at home.

Dr. Wilson avows as one of the objects of this report that "it may possibly be found useful to parties who are contemplating investments in the development of similar industries in other sections of the country," but it is surely of far greater importance to Canada that it should be in a position to utilise fully its mineral production, and to put it on the market as material ready for use in the arts, and not in an only partly manufactured condition. Surely one of the many economic lessons enforced by the present war is the need for the Empire to be as nearly as possible self-supporting, so that we may be, as far as practicable, independent of other nations for the supplies that we chiefly need. This is not always possible, because even the vast British Empire does not furnish all the natural products that we use, but in the copper smelting industry of Canada we have an example where we are deliberately giving away our natural advantages. Seeing that this is a case where both patriotic motives and commercial interests point in the same direction, it may fairly be hoped that there will be found in Canada men enterprising enough to finish what they have begun, and that the reproach that the Dominion is unable to refine its own copper production will soon be removed. This is certainly not the conclusion that Dr. Wilson has drawn, nor perhaps the one which he wishes to be drawn from his careful and comprehensive report, but it certainly is the main impression that the reader of his report is likely to carry away from its perusal. H. L.

AGRICULTURAL AND HORTICULTURAL RESEARCH.[1]

THE varied research activities manifest at Woburn are reflected in the contents of the fourteenth report. They include experiments in potato spraying, trenching, the distribution of soil particles, the effect of one crop on another, the control of the black currant mite, and the loss of manure in transit. It is not possible within the limits of a short notice to discuss all these subjects, nor perhaps is it necessary. For as is inevitable with interim reports, final results may not be expected. Thus with respect to the experiments in potato spraying with Bordeaux mixture and with Woburn paste, the report, though it advances our knowledge another stage, does not make final revelation of the secret of the prophylactic virtue of copper sulphate against late blight (*Phytophthora infestans*). Mr. Pickering recognises that the problem is complex, and inclines to the view that the spray fluid acts rather by inducing healthier foliage than by destroying the spores of the fungus (p. 30). Although on the scientific side of the question much remains obscure, Mr. Pickering records notable progress on the commercially practical side. He finds that Woburn paste used at the rate of 15 or 16 lb. is equivalent in its effect to Bordeaux mixture made from 8 lb. copper sulphate, and this although the paste contains five or six times less copper than does the mixture.

If we may offer a suggestion it is that Woburn should undertake a series of records spread over a term of years with the view of settling a question which vexes the minds of not a few of our best and biggest growers—whether in the *long run* spraying with Bordeaux mixture is or is not profitable. Those who know only the laboratory side of the subject may scoff at the question, but Mr. Pickering's experience would doubtless confirm the reviewer's, that many hard-headed lowland Scots do not spray, and give as their reason that it does not pay. Evidence from America, where large-scale spraying experiments have been carried out, would appear to put the men in the wrong, but in spite of that and similar evidence in this country, these men maintain their negative position. If, as Mr. Pickering estimates, the benefit of spraying in a year of blight is only about 10–30 per cent., and if, as is well known, spraying to be of much use must be begun before the disease appears, the unconverted grower may have economic justification for his heresy.

Mr. Pickering's experiments in bastard trenching, carried out in conjunction with Dr. E. J. Russell, lead to negative results which are at first sight surprising. For it might be supposed, from what is known of the need of roots for air, that the mere disturbance of the soil would benefit the crop. It has to be borne in mind, however, that the experiment was carried out with fruit trees, and it is at least probable that when the trees were planted the soil in which they were planted was disturbed sufficiently for their needs. Mr. Pickering is right in believing that where a hard pan exists not far below the surface, bastard trenching even without the addition of manure is of value.

When so much is done at Woburn it is almost ungracious to ask for more, but we should like very much to see the effect of the bastard trenching on a crop of vegetables—carrots or beet, for example. It is rash to prophesy in horticulture, but we incline to the belief that the effect, though perhaps not great, would be positive and not negative, as in the case of the fruit trees.

The Annual Report (1913) of the Agricultural and Horticultural Research Station at Long Ashton, Bristol, shows that this comparatively young institution is carrying out a large amount of useful work.

As is natural, much of the report is concerned with problems connected with cider and perry-making. A subject of wider interest is that of the influence of the stock upon vintage quality and other characters of apples. Growers as a class are apt to maintain that the stock exercises a considerable though ill-defined influence on the scion, and there is a good deal of scattered information on the subject. The analyses of fruit juices published in the report indicate that the nature of the stock is without influence on the quality of the juice of the fruit; save that the rates of fermentation of juices obtained from fruit grown on the Paradise stock are in most cases higher than those from fruit grown in the free stock.

For our part we are inclined to believe that light would be thrown on the subject by an investigation of the oxydases of scion and stock; for it is by no means improbable that research will discover that these potent agents may pass along the wood and bast, and thus affect the rate of chemical change in far-distant tissues.

The influence of grass on the growth of orchard trees—a subject brought into prominence by Mr. Spencer Pickering's observations—is discussed by Mr. Barker on the basis of experiments carried out at Long Ashton and in several demonstration orchards in the west of England.

Mr. Barker, beside confirming the view that grass

[1] (1) Fourteenth Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford and Spencer U. Pickering. (London: Amalgamated Press, Ltd., 1914.) Price 2s. 9d. post free.
(2) University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station. (The National Fruit and Cider Institute). Long Ashton, Bristol, 1913. Pp. 110. (Bath: *Herald* Press, n d.)

exercises a depressing influence on tree growth makes the new point that trees grown in land which is first cultivated and subsequently grassed are apt to be outdistanced in growth by those which are grown in grass from the start of the experiment. Mr. Barker suggests that this may be due to the trees previously free from the grass feeling the ill-effects of grassing all the more acutely because of their former immunity from those effects. The phenomenon does not appear to conform with current opinion, which holds that, once they are well-established, trees do not suffer from growing in grass.

PARIS ACADEMY OF SCIENCES.

PRIZES PROPOSED FOR THE YEAR 1916.

Geometry.—The Francœur prize (1000 francs), to the author of discoveries or works useful to the progress of pure or applied mathematics; Grand prize of the mathematical sciences (3000 francs), subject proposed, to apply the methods of Henri Poincaré to the integration of some linear differential equations, algebraic, and chosen from the simplest examples; the Poncelet prize (2000 francs), for work in pure mathematics.

Mechanics.—A Montyon prize (700 francs), for invention or improvement of instruments useful to the progress of agriculture, the mechanical arts or sciences; the Henri de Parville prize (1500 francs) for original work in mechanics; the Fourneyron prize (1000 francs), to the author of the most important improvements in aviation motors.

Astronomy.—The Lalande prize (540 francs), to anyone, in France or elsewhere, who has published the most interesting observation, memoir, or work useful to the progress of astronomy; the Valz prize (460 francs), to the author of the most interesting astronomical observation made in the course of the year; the Janssen prize, for an important progress in physical astronomy.

Geography.—The Tchihatchef prize (3000 francs), for the recompense or encouragement of naturalists of any nationality distinguished in the exploration of the lesser-known regions of Asia; the Gay prize (1500 francs), for improvements in instruments or methods of topometrical and topographical surveys; the Binoux prize (2000 francs), for work in geography or navigation; the Delalande-Guérineau prize (1000 francs), to the Frenchman who, as traveller or *savant*, shall have rendered the greatest service to France or to science.

Navigation.—The extraordinary prize of 6000 francs for work increasing the efficiency of the French naval forces; the Plumey prize (4000 francs), for an improvement in steam engines or other invention contributing to the progress of steam navigation.

Physics.—The Hebert prize (1000 francs), for a treatise or discovery valuable for the popularisation and practical use of electricity; the Hughes prize (2500 francs), for a discovery or work contributing to the progress of physics; the La Caze prize (10,000 francs), to the author, French or foreign, of works or memoirs contributing to the progress of physics; the Kastner-Boursault prize (2000 francs), for the best work on the various applications of electricity in the arts, industry, and commerce.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young workers already known for researches in chemistry; the Montyon (unhealthy occupations) prize of 2500 francs, and mention of 1500 francs, for the discovery of a means of reducing the unhealthiness of a trade or calling; the Houzeau prize (700 francs), for a young deserving chemist; the L. La Caze prize (10,000 francs), to the author, of any nationality, of the best work on chemistry.

Mineralogy and Geology.—The Victor Raulin prize (1500 francs), for facilitating the publication of works relating to geology and palæontology.

Botany.—The Desmazières prize (1600 francs), for the best publication during the year on Crytogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development, or description of the lower Cryptogams; the Da Coincy prize (900 francs), for work on phanerogams; the de la Fons-Mélicocq prize (900 francs), for the best botanical work on the north of France.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving a Government grant, and who study specially the invertebrates of Egypt and Syria; the Cuvier prize (1500 francs), for a work on zoological palæontology, comparative anatomy, or zoology; the Thore prize (200 francs), for the best work on the habits and anatomy of a species of European insects.

Medicine and Surgery.—The Montyon prize (prize of 2500 francs, mentions of 1500 francs), for works or discoveries judged most useful to the art of healing; the Barbier prize (2000 francs), for the author of a valuable discovery in the surgical, medical, or pharmaceutical sciences or in botany having relation to medical science; the Bréant prize (100,000 francs), for the discovery of a means of curing Asiatic cholera or discovering the causes of this disease. Failing the award of the prize, the interest on the capital sum will be awarded for advances in connection with cholera or any other epidemic disease; the Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), to a doctor or surgeon in the army or navy, for the best work presented to the academy and dealing with medicine, surgery, or military hygiene; the Bellion prize (1400 francs), for work or discoveries profitable to the health of man or to the amelioration of the human species; the Mège prize (10,000 francs), to an author who should continue and complete his essay on the causes which have favoured or retarded the progress of medicine from antiquity to the present day. The interest on this sum can be awarded by the academy as they see fit.

Physiology.—The Montyon prize (750 francs), for a work on experimental physiology; the Philipeaux prize (900 francs), for works in experimental physiology; the Lallemand prize (1800 francs), for work relating to the nervous system in the widest sense of the words; the Pourat prize (1000 francs), for a memoir on the cell constituents which exert the main influence on the water content of the different tissues; the La Caze prize (10,000 francs), to the author, French or foreign, offering the best work on physiology; the Martin-Damourette prize (1400 francs), for a work on therapeutical physiology.

Statistics.—The Montyon prize (prize of 1000 francs, and two mentions of 500 francs). The academy will consider not only memoirs sent in manuscript, but also works already printed and published which are brought to their knowledge.

History of Sciences.—The Binoux prize (2000 francs).

General Prizes.—The Arago medal; the Lavoisier medal, for eminent services to chemistry without distinction of nationality; the Berthelot medal, to persons who have been awarded by the academy prizes in chemistry; the Henri Becquerel prize (3000 francs); the Gegner prize (3800 francs); the Lannelongue prize

(2000 francs), for the relief of unfortunate scientific men or their immediate relations; the Gustave Roux prize (1000 francs), for a young French scientific worker; the Trémont prize (1100 francs); the Wilde prize (one prize of 4000 francs and two of 2000 francs), awarded without distinction of nationality for work in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs), for the best memoir on work on the diseases of man, animals, or plants from the special point of view of the introduction of mineral substances in excess as the cause of these diseases; the Saintour prize (3000 francs), for work in the physical sciences; the Henri de Parville prize (2500 francs) for original scientific work or publication; the Victor Raulin prize (1500 francs), for assisting the publication of work relating to geology and palæontology; the Houllevigue prize (5000 francs); the Caméré prize (4000 francs), to a French engineer for improvements in the art of construction; the Jérome Ponti prize (3500 francs); the Bordin prize (3000 francs), the subject proposed for 1916, researches relating to the determinism of sex in animals; the Parkin prize (3400 francs), for researches on the curative effects of carbon in various forms, and more especially in gaseous form of carbon dioxide, in cholera, the different forms of fever or other diseases, or, as an alternative subject, for researches on the effects of volcanic action in the production of epidemic diseases in the animal and vegetable kingdoms and in causing abnormal atmospheric disturbances; the Jean Reynaud prize (10,000 francs); the Baron de Jouest prize (2000 francs), for a discovery useful to the public welfare; the prize founded by Mme. la Marquise de Laplace (a complete collection of the works of Laplace) to the first student leaving the Ecole Polytechnique; the Felix Rivot prize (2500 francs), divided between the four students leaving each year the Ecole Polytechnique with the first and second places in the section of Mines and of Ponts et Chaussées.

THE ENGLISH CERAMIC SOCIETY.[1]

THE English Ceramic Society, to judge from the latest issue of its Transactions, still continues to do excellent work. Although the present number contains no article of first-rate importance, it is obvious from the general character of the communications, and the nature of the discussions by which they are followed, that the members are fully alive to the value of the society in promoting exchange of experience and opinion on the many obscure problems with which the art and craft of the potter is beset. No indication of the health and vigour of the society could be more significant than the manner in which individual knowledge and experience are made to contribute to the general benefit of the industry. Such a spirit has been far from the rule in times past, for in no other industry have trade secrets and little details of practice been more jealously guarded than in potting. The enlightened example of the society will do much to break down this absurd exclusiveness and short-sighted selfishness. If each thus contributes to the common stock, the general welfare is increased, and the position of the industry as a whole is enhanced, to the collective benefit of the manufacturers and the country generally. In this respect we have something to learn from our enemies. The spirit of co-operation has largely contributed to raise manufacturing in Germany to the formidable position it has gained. If we are to maintain, and especially if we are to increase our pre-eminence as the largest traders in the world, this spirit of co-operation and mutual helpfulness must continue to prevail, and to grow.

The communications in the present issue of the Transactions call for no special comment. The "Symposium on Fineness of Grinding" brought out a considerable difference of opinion as to the relative merits of cylinder- and pan-grinding, and as to the influence of the fineness of the particle on plasticity, contraction, texture, porosity, and "crazing"—all of them points which are capable of a satisfactory solution if attacked experimentally in a scientific manner. These are typical of the kind of problems with which the County Pottery Laboratory at Stoke-on-Trent may be expected to concern itself. The discussion on grinding bore unmistakable testimony to the influence of the human element, especially in pan-grinding. That influence was no less marked in the course of the discussion on "firing," and of the relative importance of "tops" and "bottoms," where opinion was equally divided. The average "fireman" may be (and evidently is in the opinion of some) a rather perverse and obstinately conservative kind of individual, wholly wedded to traditional practice, but if this volume falls into his hands, he may at least be able to retort that he knows more about firing than his betters seemed to know about French on the occasion of their visit to the pot-banks of our Ally! *Verb sap.* T.

[1] "Transactions of the English Ceramic Society," Vol. xiii, Session 1913-14. (Stoke-on-Trent: Hughes and Harber, Ltd., 1914). Price to non-members, 30s.

EDUCATION IN RELATION TO INDUSTRY AND COMMERCE.[1]

Our First Purpose.

WE are now in the midst of the greatest struggle that the British Empire has ever been engaged in. The outcome of the struggle involves not only our existence as a nation, but the existence of those principles and ideals of life and government which we hold dear. Our energies, individual and national, must for the moment all be turned to one purpose, to bring the war to a successful conclusion. The men who are fighting at the front are doing magnificent work, but it is for each of us in his own sphere to do his share in order that at the earliest possible moment the world may be free from the terrors of the war.

In time, peace will come. With that peace there will be renewed the international struggle for trade, and British enterprise must be ready to take full advantage of the great opportunities that will then occur. Individual effort will not be of any great use. Concerted action is essential if we are to retain the foremost place in the world of trade; and just as we are vigorous in the pursuit of the present war, so as a nation must we be vigorous in the pursuit of industrial and commercial supremacy.

The Industrial Army.

How is this supremacy to be attained? It is primarily a question of education. We must have in the first instance an industrial army, capable, alert, and well trained. The production of this army must begin in the elementary schools. The leaving age of school children, for urban districts at least, must be raised to fourteen years, and age must be made the only leaving qualification. Moreover, the children should leave at the end of the educational year in which they reach the leaving age, or, at any rate, they should leave only at the end of the school term in which the leaving age is reached. For this reform we must look to Parliament, as it is impossible for a

[1] Address delivered before the National Association of Education Officers on January 1 by the president, Mr. James Graham.

local authority to make the change in view of the many local interests involved.

With the leaving age at fourteen years, local authorities and teachers, after making a careful selection of the boys and girls who should go forward to a secondary school at the age of twelve, could turn their attention to the children left in the elementary schools, who as a body may be expected to receive very little general education beyond that obtained in the elementary schools. For these children it would be possible to organise special two-year courses which should prove extremely valuable in preparing them for the work they will undertake on leaving school.

Preparation in the Elementary Schools.

A large proportion of the boys from our elementary schools enter some trade or some branch of industry, and for these the courses of study between the age of twelve and fourteen years of age, while remaining on broad general lines, should be somewhat industrial in character. There is at the present time a strong demand for industrial or vocational education in which practical methods and manual training are involved, but it must not be forgotten that the purpose of elementary education is not to prepare for a particular trade, but rather to develop all the child's faculties so that he may be prepared to enter any walk of life. The all-round general education of the child must be the first consideration, and in the suggested courses of study no attempt should be made to teach any specific trade. The courses would be entirely preparatory and general-trades work, and would involve teaching the theory and principles which underlie British trades generally. "Learning by doing" would take the place of "book learning." An attempt would be made to put the whole boy to school, to train the entire faculties of the boy, intellectually, morally, and physically, and so fit him for life. The work which is now generally done in artisan evening schools would be covered by every boy in an urban elementary school, where the work would be done under vastly better conditions, as the teaching would be given to boys who are fresh and vigorous instead of to tired boys who have already done a day's work.

The workshops of the country require boys with self-effort, self-reliance, initiative, and thought, and it should be the object of these courses to provide just that training which would develop these habits. The general adoption of this development in elementary education would create in the near future a supply of intelligent boys, who would rapidly become in the workshops intelligent and skilled workers, ready and able to adapt themselves to the changing working conditions of the trade and of the times; and we should hear no more of the employers' complaint that the present product of the elementary schools is not the type of youth they require in their shops.

In the proposed courses, roughly one-third of the school time of the boy during the age of twelve to fourteen should be devoted to the study of English subjects, one-third to mathematics and technical drawing, and the other third to actual experiments and practical work in the laboratory or workshop. The scheme of instruction would be arranged with the intention of securing an all-round development of the boy's faculties in a thoroughly practical manner, in order that by the time the boy is ready to commence work he may possess not only a general grip of the principles which underlie trades in general, but such intelligence, reasoning power, and adaptability as are calculated to secure for him the approval and good will of his employer.

This preparatory practical training before the boys enter the workshop or factory is the first step in the production of a capable industrial army. I reiterate that at this stage the practical training must be general; there must be no attempt to teach any specific trade, but every effort must be made by curriculum and by method to develop all the faculties of the boy.

Education of Boys in the Workshops and Factories.

We now come to the second age period and deal with the problem of the boys from fourteen to eighteen years of age. The boys have now left the school. They are in the workshops, and specific trade instruction must begin. Opportunities must be provided for the boy to lay the foundation of a livelihood which in the main will persist through life. At the same time it must not be forgotten that the boy is something beyond a potential wage-earner or producer. He is a future citizen, and in the scheme of education for such youths time and opportunity must be provided not only to enable him to understand the occupation which he has entered and from which he is to obtain his livelihood, but also to enable him to understand his duties as a citizen. There should be provided opportunities for mental, physical, and moral training which shall fit him for manhood and for his place in the nation.

The Teaching of Trades.

The modern workshops are highly organised and specialised with a view to enable employers to reduce the cost of production and to compete successfully for orders; consequently it is practically impossible to-day for an English boy to learn the whole of a trade in a workshop. It is in this connection that the technical schools of the country working in close co-operation with the workshops should fulfil their real function. When the boy enters the workshop his education is far from complete, even if he has had the general practical training outlined above. Continued education applicable to his chosen trade must be given, and the problem that confronts us is how best to ensure that the boy shall have this technical education in spite of the fact that the industrial conditions are vastly different from what they were.

In the old days the employer was the sole educator of his apprentice or young worker. Under present conditions it is impossible for the employer to give the young worker all the instruction he requires. The schoolmaster, therefore, has been called in to undertake part of the work. Under this divided responsibility, the work of the teacher is to give the young worker a thorough grasp of theoretical principles and to provide him with such knowledge and training as will enable him to adapt himself to changed conditions, to attack new problems, and to show initiative and skill in his work. The duty of the employer, on the other hand, is to give that advice and assistance to the teacher as will ensure that the work of the school shall not be merely academic but essentially practical, and to supplement the instruction by doing all that is possible to give the young worker ample opportunities for getting an all-round experience of his trade.

At the present time the young worker is expected to get the necessary technical education by attending the school for three or more evenings a week after he has done a full day's work in the workshop or in the factory. It is quite unnecessary to point out the drawbacks and disadvantages of this system. Excellent work has been done in the evening schools by youths of grit and character, who have attended them, and a number of employers have done a good deal by means of suitable inducements to encourage their young workers to take full advantage of the opportunities for gaining increased knowledge and experience—but voluntary attendance at evening

schools and voluntary schemes of co-operation between employers and educational authorities do not really touch the huge problem. The only effective way to train the rising generation of skilled workmen after leaving the elementary schools is to have half-time in the workshop and half-time at the technical school between the ages of fourteen and eighteen. In the words of our friend, Mr. J. H. Reynolds, the solution of the problem is "Half-time at the right time." Good health and physique are as necessary to the skilled workman as is the technical knowledge applicable to his trade, and the youth should have the opportunity of obtaining this technical knowledge without detriment to his health. In other words, he should be allowed to attend suitable courses of instruction for periods of suitable length within the normal working day.

Half-time in the workshop and half-time at the technical school is certainly ideal, but possibly at present it is not practicable. At least some modification of this arrangement must be adopted to enable young workers to attend day courses on three or four half-days a week, and thus get the necessary continued education during the daytime. Only a small proportion of the young workers of the country attend evening schools in spite of all the inducements offered and all the encouragement given, and no one would assert that they derive the greatest benefit from their attendance. The result would be infinitely better if the youth spent sixteen to twenty hours a week during the daytime at the technical school and the remainder of his time at the works.

If England is to maintain her place in the world as an industrial and commercial nation, she will have to adopt this method of teaching trades to her boys. Other nations are doing a great deal in this direction. We must do more than they because we have more at stake, and we must act promptly and boldly. Legislation is necessary; it must be made the duty of the employer to allow to the employee the time required for continuing his education according to the requirements of the trade or business which the boy enters. The need for a further limitation of juvenile labour is urgent, and it is equally necessary to place employers of labour under statutory obligation to enable young persons under eighteen years of age who are in their employment to attend courses of technical and general instruction at certain hours of the daytime when they are not too tired bodily and mentally to profit from the instruction. An Act of Parliament limiting the hours of employment for all young persons under eighteen and placing that limit so low that there shall be ample time during the normal working day for attendance of the young people at suitable courses of instruction is required.

The Leaders of Industry.

An army requires capable leaders, and there must be in connection with the training of an industrial army opportunities for the selected few to become successful leaders of industry. For these no education can be considered too good. A thorough training in the secondary schools and the universities, combined with adequate experience in a workshop or factory, is necessary. Science now plays so important a part in industry that more vigorous efforts than hitherto must be made to secure the highest and most suitable education and training for capable youths, and the future leaders of industry in England must be induced to equip themselves for competition on equal terms with the more highly trained young men of other nationalities.

The value of a thorough general education in the secondary school and university cannot be overstated, and full technical knowledge of the particular industry is equally necessary. The training of the young men must be practical as well as theoretical; actual experience in the workshop or factory is as important as the scientific training at the technical college or university, and service in a recognised office, workshop, or factory must be compulsory for a period either before or after the college course, or during the continuance of the college course. The period of training for the men who are to fill the higher posts in industry should be at least for a period of six or eight years, in order that the student may have time to develop his powers of thought and to obtain a complete knowledge of the theory and principles underlying the industry, together with a first-hand knowledge of the processes of the industry obtained by actual contact with it in the workshop or factory.

Some of the highest posts in industry will be filled by men who, in the first instance, enter the works as youths, and who on account of their unusual capacity force their way through the various grades to fill positions of responsibility. It is of the greatest importance that opportunity should be provided for youths of proved ability to secure the education and training required of those who fill the highest positions in industry if for financial reasons their parents are unable to provide that training. In this connection a duty falls upon the local education authority to make special provision for the benefit of such youths. Scholarships must be provided to enable young workers of proved ability to attend day courses at the technical college or university for three or four years in order that they may obtain a professional training that will prepare them to fill posts of greater responsibility in the future.

In the past, England has had too few specially trained leaders of industry. To organise industry, men, shrewd, enterprising, and with full knowledge regarding the application of scientific methods in the development of industry are required. For these men there must be a most comprehensive and thorough education and training on the solid foundation of a good general education. They must have a sound knowledge of the mutual relation of science and industry and an intimate knowledge of their particular industry in order that all problems may be attacked systematically and on a scientific basis. Men of practical capacity and trained thinkers, endowed with the power of applying their knowledge to the practical necessities of industrial processes are essential in the industrial army, and the absence of a comprehensive scheme for the training of such men must prejudice the future of our country.

Commercial Army Necessary.

It is not sufficient to have a well-equipped industrial army; there must be markets for the products of industry. The goods produced must be sold, and we must have, therefore, a commercial army as well trained and equipped for the work of distribution as the industrial army is for the work of production.

It has often been stated that England is deficient in what is usually called technical education, but we must frankly acknowledge that she is infinitely worse off in regard to commercial education in spite of the development of this type of education during recent years.

The United Kingdom still ranks first among the commercial countries of the world, with its enormous annual imports and exports, its immense home trade, and its great shipping trade. We not only carry the whole of our own commodities, but we do an enormous amount of carrying for other countries. In view of these facts it is strange that commercial education

should have been so strangely neglected in England. Travellers, agents, and consuls representing the interests of British trade abroad are generally foreigners who have been thoroughly trained in the practice and theory of business while at home. The majority of our foreign correspondents and managers of firms with branches abroad are likewise foreigners. For years we have been giving the foreigners a practical experience and knowledge of our manufactures and methods of business which qualify them to meet us as strong competitors. These foreigners come in large numbers; they very often enter our business houses with a view of acquiring information as to the inner working of the firm's business connections, and on going back to their own country they join a rival establishment or set up an establishment of their own.

English firms are driven to the employment of foreigners because young men in England do not pay sufficient attention to commercial education and to the study of foreign languages.

The Training of a Commercial Army.

This state of affairs cannot be allowed to continue. We must produce an army of trained traders, and in the production of this army education must play a prominent part.

The first essential for one who is to enter a commercial career is a sound general education in which the study of English and at least one foreign modern language should be of first importance. Any intending business man should have a secondary-school education and specialised commercial study should not be commenced until the age of fifteen at least. In many good secondary schools commercial sides are organised for the higher forms, and the studies of the pupils are given a certain amount of commercial bias.

The commercial education so given is strikingly inadequate in comparison with the provision in other countries. Unfortunately we in England still retain the idea that a small amount of education is sufficient for a man destined to be a trader, whereas other countries are more enlightened, and they endeavour to provide for the future trader the highest education applicable to his walk in life.

Schools for Commercial Education.

England in this matter has delayed far too long. It is now essential that there should be established in this country schools of commerce which in our English system might well form one side of our secondary schools, with a curriculum specially designed for the higher education of young people who are destined for a business career. The teaching staff must be really competent, and the school must be equipped for teaching the theory of business, and as much of the practice of business as possible, the general aim of the school being to train well-equipped employees of all grades from the competent clerk to the competent employer.

A Typical School of Commerce.

Belgium was the first nation to give practical effect to the idea of establishing a special college for the commercial training of her young men. The aim of the exhibition held at the Crystal Palace in 1851 was to compare the progress made by the different peoples in the development of the industrial arts. It was recognised that England held the first place. But while we rested complacently on our oars, other nations profited by the lesson and began to take steps to promote their home and foreign trade. Belgium recognised that competent men to represent her in the foreign markets were required, and as a result the Higher Commercial Institute at Antwerp came into existence. It was to be to the men destined for a commercial career what the university was to the doctor or the lawyer. Similar institutions have since been founded in France, Switzerland, Germany, Austria, Italy, and even in distant Japan. Before admission candidates must show competent knowledge as tested by an entrance examination. The curriculum embraces the study of all subjects, a knowledge of which is indispensable to the merchant, the banker, or the trader, including at least two foreign languages, book-keeping, commercial documents, geography, history, arithmetic, and algebra, commercial law, and the elements of political economy, as well as physics and chemistry. The course of study is practical as well as theoretical. Transactions of a large commercial house are simulated, the operations of a counting-house are minutely practised and all questions relating to the theory of exchanges are carefully described. Correspondence is conducted by the student in French, German, and English. The principles of international commercial law and customs' legislation are inculcated, and special care is taken to make the student acquainted with foreign markets by furnishing him with reports sent in periodically by Belgians resident abroad. To further the knowledge of all kinds of vegetable, mineral and animal products, there is a well-furnished museum with samples and patterns kept up to date, so that the professor is able to give to his pupils a direct knowledge of the article, in which the latter may one day be called upon to trade. The actual political and economical condition of foreign countries is studied from carefully compiled data and the relative value of raw material from different sources of supply is inquired into and noted. The student is encouraged to take a close interest in the political events of to-day so far as they affect commercial interests, and the latest consular reports from all countries are placed at his disposal, so that he himself later on may be in a position to make a report upon the commercial practice of any country in which he may happen to find himself. Visits to factories, mills, mines, etc., enable the student to acquire an insight into the actual working of those industrial establishments.

Valuable travelling scholarships are given to the best students, who are thus relieved of the necessity of accepting the first situation that is offered to him. He is enabled, in fact, to study the economical condition of the country in which he resides, but he must send home periodically a detailed report of the result of his observations. These reports, after being noted by the Government, are utilised by the students in the prosecution of their studies.

The Training of Clerks.

For those engaged in business who are not able to attend full time at a day school of commerce, arrangements should be made by which they should be able to attend such schools on three or four half-days a week during the normal working hours. The young worker in a house of business is in the same difficulty as the young industrial worker: he cannot get an all-round training; and at present he must get his theoretical knowledge of commerce by attendance at a commercial evening school on three evenings a week. This system is unsatisfactory; but by a part-time attendance at a day school of commerce, he might go through a modified course of instruction which combined with his experience in a business house should make him far better fitted for the post he is filling.

Training for the Consular Service.

In the school for commerce the highest courses are arranged for the special purpose of fitting the student

for the Consular Service. At the present time England is generally represented abroad by a foreigner whose first interests naturally are not British. What we require is that every Consul representing British interests should be an Englishman specially trained for the service, with a full knowledge of British trade, and ready and able to place British interests first.

A Liberal Education Necessary.

Our travellers, managers, agents, and responsible clerks in connection with all branches of industry should be properly trained. They should complete a course of study applicable to their particular calling, including modern languages for commercial purposes, commercial arithmetic, book-keeping and accounts, commercial practice, geography and history of commerce, economics and commercial law. At the same time it cannot be too strongly urged that opportunities must be provided for education apart from the purely utilitarian form.

The period between fourteen and eighteen years of age is a vital period during which the youth should have the opportunity of fitting himself for livelihood and for life. He should have the opportunity of learning in the fullest sense his trade or business and of developing those faculties of mind, body, and spirit that would enable him to fulfil his duties to his neighbours and to the nation. The school course should, therefore, offer beyond the purely technical or commercial subjects other subjects of a liberal character. The youth is not merely a wage-earning industrial or commercial; he is a human being, and his education and training should enable him to occupy his leisure time to good advantage.

Responsibility of Education Officials.

A responsibility rests upon us as education officials. It is for us to see that the educational needs of the nation are really appreciated, and that the fullest educational opportunities are provided for all. If we rightly do our part there should arise in England an industrial army and a commercial army capable of maintaining for our country that industrial and commercial supremacy which is vital to a nation so situated as we are.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The *Cambridge Review* has just published the names of the past and present members of the university who are serving in some capacity in the King's Forces. The number amounts to 7,237, and they are distributed amongst the colleges as follows:—Trinity College, 1,840; Pembroke, 760; Gonville and Caius, 616; Clare, 535; King's, 436; Jesus, 385; Emmanuel, 371; Christ's, 359; St. John's, 337; Trinity Hall, 328; Magdalene, 214; Queen's, 179; Sidney Sussex, 154; Peterhouse, 140; Downing, 126; Selwyn, 125; St. Catherine's, 117; Corpus Christi, 109; Fitzwilliam Hall, 90; Honorary Graduates, 16. With one or two exceptions the numbers run parallel with the sizes of the colleges in normal times, and the list is, with these exceptions, in much the same order as the colleges would be classified if they were arranged on a basis of the number of students.

The General Board of Studies has appointed Mr. K. J. J. Mackenzie, of Christ's College, Reader in Agriculture.

LONDON.—Two appointments to the university professorships were made by the Senate on January 27. Dr. Edward Barclay-Smith, of Cambridge, succeeds Prof. Waterston in the Chair of Anatomy at King's College, and Dr. E. P. Cathcart, of Glasgow, succeeds Prof. Leonard Hill in the Chair of Physiology at London Hospital Medical College.

The D.Sc. Degree has been granted to the following:—Mr. E. L. Kennaway, Guy's Hospital, for physiological chemistry; Miss Ethel N. Thomas, University College, for botany; Mr. J. Kenner, East London College, for chemistry; and Mr. J. Kenyon, external student, for chemistry.

The Hon. R. C. Parsons succeeds Prof. Cormack as one of the representatives of the university on the governing body of the Imperial College of Science and Technology.

MANCHESTER.—At a meeting of the Court of the University held on January 27 Sir Henry Miers, F.R.S., was appointed Vice-Chancellor, in succession to Prof. Weiss, whose resignation takes effect in September. The nomination of Sir Henry Miers had previously received the unanimous approval of the Senate and Council. Since the resignation of Sir Alfred Hopkinson arrangements have been made to lighten the administrative duties of the Vice-Chancellorship, and it is hoped that in the appointment of a distinguished man of science to this office additional strength may be given to the advanced teaching and research work of the University. A proposal will shortly be brought forward to establish a professorship of crystallography, to which the new Vice-Chancellor will be appointed.

OXFORD.—The friends of the late Mr. Arthur Elam Haigh, sometime fellow of Hertford and fellow and tutor of Corpus Christi College, Oxford, will have heard with regret of the death of his elder son, Lieut. Charles Roderick Haigh, Adjutant of the 2nd Battalion Royal West Surrey Regiment, who was killed in action in Belgium on November 7. Lieut. C. R. Haigh has left several large bequests to educational and charitable objects, among them being the establishment of a scholarship at Corpus Christi College and another at Leeds Grammar School, both in memory of his father. There are further bequests to Winchester College, to the Oxford Preparatory School, to Oxford Temperance and Surgical Aid Societies, and to his old regiment.

The University has adopted a series of decrees allow a certain relaxation of the regulations concerning the keeping of terms and payment of dues in the case of those of its members who are serving in the war.

IT is announced in the issue of *Science* for January 22 that Pomona College, Claremont, Cal., has completed the collection of an endowment fund of 200,000*l.* towards which the General Education Board contributed 30,000*l.*; also that Mrs. Russell Sage, who had undertaken to give 20,000*l.* towards a 100,000*l.* dining hall for Princeton University, has increased her offer to 50,000*l.*, provided an equal sum is collected by July 1. Sums amounting to 15,000*l.* have been subscribed.

COMMENTING upon an article in the January issue of the Technical Journal of the Association of Teachers in Technical Institutions on the Massachusetts Institute of Technology in NATURE for January 21 (vol. xciv., p. 580), we reminded our readers that in this well-known college there is a continual weeding out of those students who do not display the requisite ability and application. We might have added that this plan is common in American institutions of higher education, and is adopted in many of our own technical colleges. In the faculty of engineering of the University of Bristol, for example, Prof. J.

Wertheimer writes to say that the system has prevailed for many years, and that it has resulted in a great increase of efficiency and in an improved prestige of the college in the eyes of the heads of the firms which employ students who have gone through their engineering training at Bristol.

THE King has appointed a new Royal Commission for the following purposes:—To inquire into and report on the methods of making appointments to and promotions in the Civil Service, including the Diplomatic and Consular Services, and the legal departments; to investigate the working and efficiency of the system of competitive examination for such appointments, and to make recommendations for any alterations or improvements in that system which may appear to be advisable; and to consider whether the existing scheme of organisation meets the requirements of the Public Service, and to suggest any modifications which may be needed therein. The members of the Commission are as follows:—Sir H. B. Smith (chairman), Duke of Devonshire, Bishop of Southwark, Sir J. P. Hewett, Sir Donald Macalister, Sir J. A. Kempe, Mr. S. J. G. Hoare, Mr. A. C. T. Beck, Mr. A. A. Booth, Mr. A. Boutwood, Mr. J. R. Clynes, Mr. C. Coward, Mr. R. D. Holt, Mr. P. E. Matheson, Dr. A. E. Shipley, Mr. P. Snowden, Mr. Graham Wallas, Miss E. S. Haldane, and Mrs. L. A. E. Streatfeild.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 28.—Sir William Crooks, president, in the chair.—W. W. C. **Topley**: The influence of salt-concentration on hæmolysis. The method employed in this investigation has consisted in varying the percentage of sodium chloride present in a mixture of sheep's red cells, hæmolytic anti-body and complement. The hæmolytic anti-body was obtained from an immunised rabbit, and fresh guinea-pig serum, previously absorbed with sheep's red cells at 0° C., furnished the complement. Where hypotonic percentages of sodium chloride have been employed, the solutions have been made in 7·8 per cent. saccharose solution. The results have confirmed the observations of other workers that, when the percentage of salt is increased beyond the normal limit, hæmolysis is inhibited, owing to the failure of union between the complement and the red-cell anti-body complex, and that, if the amount of anti-body present in the mixture be increased, the effect of the increased salt concentration may to a certain extent be overcome. It has further been shown that, if the salt concentration be decreased below the normal limits, less and less anti-body becomes necessary in order to bring about the union of red cells and complement, and that, in the almost entire absence of electrolytes, guinea-pigs' complement can hæmolyse sheep's red cells without the intervention of hæmolytic anti-body.—G. **Smith**: The life-cycle of Cladocera, with remarks on the physiology of growth and reproduction in Crustacea. As the result of breeding experiments, it is shown that the effects of isolation, crowding, and temperature are the same for *Daphnia pulex* as previously reported for *Moina rectirostris*, viz., isolation combined with high temperature completely inhibits the production of sexual individuals, reproduction being entirely parthenogenetic. Crowding, combined with low temperature, results sooner or later in the production of males and ephippial females.—T. **Goodey**: Investigations on protozoa in relation to the factor limiting bacterial activity in soil. Two different lots of soil were taken and inoculated with cultures of protozoa originally obtained from soil, in order to determine whether the added protozoa would cause a decrease in the numbers of bacteria in the soil. One soil was free from protozoa to begin with, having been bottled since 1846, whilst the other was freed from protozoa by partial sterilisation. Separate lots of each soil were inoculated with cultures of ciliates, amœbæ, and flagellates, and suitable control samples were set up. Periodical bacterial counts were made in order to ascertain if the protozoa were exerting a limiting action on the soil bacteria, and these counts were continued over a period of about eighteen months. The general conclusion drawn from the investigations is that ciliates, amœbæ, and flagellates do not act as the factor limiting bacterial activity in soil.—S. **Hatta**: The mesodermic origin and fate of the so-called mesectoderm in petromyzon. The name mesectoderm has given to a loose aggregation of mesenchymatous tissue, in some places assuming the character of an epithelium intervening between the myotomes and the ectoderm in the head and branchial region of the embryo of petromyzon. As the name implies, it has been confidently asserted that this tissue is derived from the ectoderm. In this paper, however, it is shown that this tissue originates from the ventral edge of the myotome and corresponds to the ventral extension of the myotome in the trunk region which grows downwards towards the mid-ventral line outside the splanchnocœle and gives rise to the ventral muscles of the trunk.—Prof. J. C. **Bose**: The influence of homodromous and heterodromous electric currents on transmission of excitation in plant and animal. The action of an electric current in inducing variation of conductivity may be enunciated under the following laws, which are equally applicable to the conducting tissue of the plant and the nerve of the animal:—(1) The passage of a current induces a variation of conductivity, the effect depending on the direction and intensity of current. (2) Under feeble intensity, heterodromous current enhances and homodromous current depresses the conduction of excitation. (3) The after-effect of a feeble current is a transient conductivity-variation, the sign of which is opposite to that induced during the continuation of current. (4) The normal conductivity-variation undergoes a reversal under a strength of current above the critical value. The heterodromous current then induces a depression while the homodromous current induces an enhancement of conductivity.

Geological Society, January 20.—Dr. A. Smith Woodward, president, in the chair.—Prof. O. T. **Jones** and W. J. **Pugh**: The geology of the district around Machynlleth and the Llyfnant Valley. An account is given of the physical features, general succession, and structure of the area. The rocks are sharply folded, and sometimes overfolded, towards the east. Their axes range approximately north-north-east and south-south-west; the folds in the central area pitch northwards, but north of the Dovey a southerly pitch sets in. Each large fold is composed of a number of smaller folds having parallel axes, and changing in pitch more frequently than the larger folds. Strike-faults of considerable magnitude range nearly parallel with the folding axes, and are in all cases overthrusts towards the east. Of interest are the transverse faults ranging nearly east-north-east and west-south-west. Two of these faults, the Pennal and Llyfnant Faults, are shatter-belts. The Llyfnant Fault displaces several folding axes, and overthrusts to the east on the north side. Its vertical displacement is on an average about 300 ft., but its horizontal displacement is usually more than 3000 ft. It may therefore be called a "tear-fault."—Dr. A. H. **Cox**: The geology of the district

between Abereiddy and Abercastle (Pembrokeshire). The stratigraphy and structure of the greater part of the district is described for the first time. Abereiddy itself has been, since the time of Hicks, a type-locality for the Llanvirn Beds. It has been found that the Ordovician rocks of the district do not succeed one another in a simple upward sequence, but that they have been thrown into great folds and sometimes even overfolded. The limbs of the folds increase in steepness as the pre-Cambrian massif is approached. This folding brings up strips of Cambrian rocks, the presence of which on the North Pembrokeshire coast was previously unsuspected. There is a complete sequence of Ordovician rocks from near the base of the Arenig Series to high up in the Glenkiln Group.

Linnean Society, January 21.—Prof. E. B. Poulton, president in the chair.—W. J. **Dakin**: Structure and fauna of the Abrolhos Islands. Percy Sladen Trust Expedition. The islands are situated 40–50 miles off the coast of West Australia. They are interesting because of the almost complete lack of knowledge concerning the marine fauna of that part of the world. In addition, however, they possess many peculiar features of their own. Although they are coral islands (the most southern in the world), the land fauna is decidedly continental and indicates a comparatively recent connection with the mainland of Australia. Again, although the coast is only forty miles east of the islands, one has to travel some hundreds of miles north of the latitude of the Abrolhos to find a marine fauna on the coast with such tropical characters. The collections have not yet been worked out, but not the least interesting of the discoveries is a new species of Enteropneusta, *Ptychodera pelsarti*, closely allied to varieties of *Pt. flava*. This is the first Enteropneust known from the West Coast of Australia.

Institution of Mining and Metallurgy, January 21.—Mr. Bedford McNeill, past president, in the chair.—J. A. L. **Henderson** and W. H. **Henderson**: Inflammable natural gas as an economic mineral. The authors set out to show that natural petroleum-gas is the only inflammable natural gas of economic value, in its two divisions of "dry" or gas-well gas, and "wet" or "casing-head" gas, which is chiefly produced from oil wells. The former is of chief commercial importance, as it is capable of direct use for heating, power, and lighting purposes as it comes from the well. The occurrence of natural petroleum is co-extensive with that of petroleum, though the reverse is not always true, as is shown by the relative acreages of gas and oil fields in the United States in 1911, which were 11,132,642 and 8,322,862 respectively. The greatest and most extensive natural gas deposits of economic importance, so far as known, are found in the older, drier, and more consolidated porous sedimentary rocks from the Cretaceous downward. In the United States the industry has developed to such an extent that in 1913 the value of natural gas produced almost equalled that of the gold produced. Natural gas has within the last ten to fifteen years become a formidable rival to petroleum in output, and even in value, despite the enhanced prices that the oil has commanded in recent years. In addition to the gas production of the United States, which easily stands first, the authors direct attention to the occurrences in Canada, Russia, Galicia, Italy, Transylvania, and even in England.—J. **Cook**: Investigations in ore milling to ascertain the heat developed in crushing. As the result of carefully conducted experiments with an electrically driven stamp mill the author established the following data: Of the E.H.P. supplied to the motor only 76 per cent. was apparently stored in the raised stamp; the ore crushed was raised in temperature an average of 4·8° C., while the water used was raised an average of 0·438° C. Of the actual E.H.P. put into the motor, practically 61 per cent. was returned as heat in the pulp. Of the energy which reached and was stored in the lifted stamp, practically 80 per cent. was returned as heat in the escaping pulp. In the latter case the author allocates the remaining 20 per cent. unaccounted for as heat to (*a*) loss by friction of the guides, (*b*) loss in sound and vibration, (*c*) loss in radiated heat, and (*d*) the larger proportion, loss due to the energy with which the pulp is delivered through the screens. The test was borne out by the fact that the screens had in places a perceptibly higher temperature than the pulp. The author asks: Is the energy used in tearing the ore particles asunder entirely returned as heat, and do some electrical phenomena exist?

Mineralogical Society, January 26.—Dr. A. E. H. Tutton, president, in the chair.—S. **Kôzu**: The dispersion of felspar. By the most refined methods the dispersions in the three principal directions were determined for various members of the felspar group.—F. P. **Mennell**: Note on the colour of some alluvial diamonds and of pyrrhotite. The colour, usually green, of the diamonds in the gravels of Somabula, Rhodesia, is superficial, and probably due to infiltration, presumably of iron salts, while the stones were lying where they now occur. Pyrrhotite is tin-white in colour when fresh. The cause of its rapid alteration was discussed.—Prof. G. **Cesàro**: Crystals of calomel from Spain. The crystals, which were pale-yellowish in colour, imperfectly transparent, from 1–3 mm. in size, and displaying the forms 100, 111, 311, were most irregularly developed.—Prof. G. **Cesàro**: General formula for the birefringence of a crystal-plate in terms of the angles which its normal makes with the principal optical axes. The approximate formula is obtained by supposing the mean index of refraction to become infinite, while the differences between it and the greatest and least indices remain constant.—Prof. G. **Cesàro**: A numerical relation of the sum of the symmetry-axes situated in the symmetry-planes of a polyhedron. If $N \cdot A_n$, $P \cdot A_p$, $Q \cdot A_q \ldots$ are the axes of symmetry lying in the planes of symmetry, then—

$$4\{Nn(n-1)+Pp(p-1)+Qq(q-1)+\ldots\}+1=C,$$

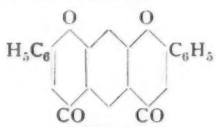
and the number of planes of symmetry is given by $X=\frac{1}{2}(C+1)$.

DUBLIN.

Royal Irish Academy, January 11.—Rev. J. P. Mahaffy, president, in the chair.—S. B. **Kelleher**: A three-dimensional complex variable. Some properties of expressions of the form $P+Q\theta+R\theta^2$ where P, Q, R are functions of three independent variables and θ^3 is equal to unity, but $1+\theta+\theta^2$ is not zero.—R. **Southern**: Summary on marine distribution (Clare Island Survey). This paper is in the nature of a summary of the results obtained by the investigation of the marine fauna of the Clare Island area. The nature of the coast-line and sea-bottom is described, and the various types of habitat and the associations of animals inhabiting them are discussed. The distribution of the fauna from the geographical point of view is then considered. Some observations on the period of reproductive activity of various species are included. A description of the hydrographical results obtained in the course of the survey is given. The total number of marine species of animals obtained in the course of the survey is approximately

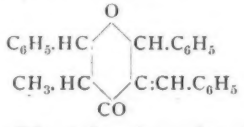
two thousand, a much larger number than has hitherto been found in any similar area.—R. **Lloyd Praeger**: Summary on terrestrial distribution (Clare Island Survey). The work of the Clare Island Survey now closing has occupied just six years, the first three being devoted to field-work and the last four to publication, there being an overlap of one year in the two sections. More than one hundred workers took part, and without exception the authors of the sixty-eight reports in which the results are embodied themselves visited the area. Besides papers on almost every group of the plant and animal kingdoms, the report includes contributions on the history and archæology of the area, on Gaelic names of animals, plants, places, and human families, climatology, and geology. The total number of species of animals obtained is about 5100, and of plants about 3200, total more than 8300. Of these no fewer than 1825 are additions to the fauna or flora of Ireland. More than 400 are new records for the British Isles, and more than 120 are new to science. Two new families and fifteen new genera are described.

January 25.—Dr. F. A. Tarleton, in the chair.—H. **Ryan** and Miss P. **O'Neill**: Studies in the diflavone group.—I., Diflavone. With the view of extending our knowledge of the relations between constitution and colour in the oxygen dyes, the authors have prepared a substance which has, as its formula, two flavone rings in a condensed form. It was obtained from diacetoresorcinol in two ways:—(1) Diacetoresorcinol dimethyl ether was condensed with benzaldehyde to dihydroxydichalkone dimethyl ether which reacted with aluminium chloride to give dihydroxydichalkone and the tetrabromide of the diacetate of dihydroxydichalkone on treatment with alcoholic potash yielded diflavone. (2) Dibenzoylacetoresorcinol dimethyl ether was formed by condensation of benzoic ester with diacetoresorcinol dimethyl ether, and was converted by hydriodic acid into benzoylacetomethoxyflavone, and finally into diflavone. The latter formed



Diflavone

pale yellow crystals, which gave a beautiful blue fluorescence with concentrated sulphuric acid.—H. **Ryan** and Rev. J. **Dunlea**: In endeavouring to synthesise dicinnamoylmethane the authors condensed benzaldehyde with mono- and di-methylacetylacetone by means of gaseous hydrochloric acid. The product in both cases was identical, being a chlorinated body which, on treatment with pyridine, yielded a substituted pyrone of the formula:—



The substance did not form an oxime, but added on hydroxylamine apparently at the unsaturated linkage It formed a dibromo-derivative.

PARIS.

Academy of Sciences, January 23.—M. Ed. Perrier in the chair.—G. **Bigourdan**: Description of a new instrument for the differential comparison of great angular distances in the sky. A movable platform carrying two telescopes is fixed to an equatorial mounting in such a manner that the axis about which the platform can move coincides with position usually occupied by the optical axis of the equatorial. The two telescopes can turn round axes normal to the platform, and are furnished with ocular micrometers. The use of the instrument, which forms a sort of angular comparator, is described. It will prove specially suitable for the direct determination of refraction, the measurement of the annual aberration constant, and correcting the fundamental star catalogues by comparison of large differences of right ascension, independently of clocks and of variation of instrumental constants.—André **Blondel**: The useful effect of projectors. Additional remarks.—E. **Delorme**: New treatment of nerves wounded by projectiles. The general principles underlying nerve operations are stated, together with full details of the methods employed.—J. **Bosler**: The red region of the spectrum of stars of the Wolf-Rayet type. Photographs of the red end of the spectrum of fifteen stars of this type, utilising plates sensitised by means of dicyanine. Comparison of the spectra confirms the view that stars of the Wolf-Rayet type represent waning Novæ of past ages. New stars appear generally in dense star clusters, and the Wolf-Rayet stars also have the same peculiarity.—F. **Devoto**: Observations of Delavan's comet (1913*f*) made at the Paris Observatory. Observations and positions of comparison stars are given for December 24, 28 (two), 29, January 8, 11, 18.—S. **Stoilow**: Quadruply periodic functions.—Paul **Mansion**: Demonstration of the law of large numbers.—Stanislas **Meunier**: A remarkable consequence of volcanic theory.—Emile **Belot**: Orogenic theory arising from the physical theory of the formation of oceans and primitive continents.—Edmond **Gain** and A. **Jungelson**: Maize seeds resulting from the growth of free embryos. The embryos were extracted from the seeds, carefully cleaned from all reserves of albumen, and sown in natural soil. The plants obtained produced seed of normal type.—H. **Jumelle** and H. Perrier de la **Bâthie**: A slightly known Cucurbitaceæ of Madagascar.—MM. **Rivier** and **Dupoux**: A new method for the rapid production of radiographs on ferrotype plates.—P. **Carnot** and B. **Weill-Hallé**: Culture in sand tubes for the rapid diagnosis of typhoid fever, and searching for germ-carriers.—Henri **Coupin**: The organic nutrition of a marine bacterium. A. **Trillat**: Study on the aqueous microbial dusts of inhabited places.

BOOKS RECEIVED.

University of Melbourne. Medical School Jubilee. Pp. 108. (Melbourne: Ford and Son.)

The Observer's Handbook for 1915. Pp. 76. (Toronto: Royal Astronomical Society of Canada.)

Anuario del Observatorio de Madrid. Para 1915. Pp. 703. (Madrid: Bailly-Baillière.)

Memoirs of the Geological Survey. England and Wales. The Geology of the South Wales Coalfield. Part xi. The Country around Haverfordwest. Pp. viii+262. (London: H.M.S.O.; E. Stanford, Ltd.) 3*s.* 6*d.*

Memoirs of the Geological Survey. Scotland. The Geology of the Country round Beauly and Inverness, including a Part of the Black Isle. Pp. vi+108. (London: H.M.S.O.; E. Stanford, Ltd.) 2*s.*

Genetic Studies on a Cavy Species Cross. By Prof. J. A. Detlefsen. Pp. 134+10 plates. (Washington: Carnegie Institution.)

A Pilgrim's Scrip. By R. Campbell Thompson. Pp. xii+345. (London: J. Lane.) 12*s.* 6*d.* net.

An Introduction to the Study of Colour Vision. By Dr. J. H. Parsons. Pp. viii+308. (Cambridge University Press.) 12*s*. 6*d*. net.

Smithsonian Miscellaneous Collections. Vol. lxiii., No. 8. Explorations and Field-Work of the Smithsonian Institution in 1913. Pp. 88. Vol. lxiii., No. 9. The Olfactory Sense of Insects. By Dr. N. E. McIndoo. Pp. 63. (Washington: Smithsonian Institution.)

Insects and Man. By C. A. Ealand. Pp. 343. (London: Grant Richards, Ltd.) 12*s*. net.

An Atlas of Economic Geography. By Dr. J. G. Bartholomew, with Introduction by Prof. L. W. Lyde. Pp. lxvi+96 pages and of maps. (London: Oxford University Press.) 5*s*. net.

Determinacion de la Hora por Alturas Absolutas, Correspondientes é Iguales de Distintas Estrellas. By C. Puente. Pp. 211. (Madrid: Bailly-Baillière.)

The Principles of Understanding: An Introduction to Logic from the Standpoint of Personal Idealism. By H. Sturt. Pp. xiv+302. (Cambridge University Press.) 5*s*. net.

Oxford Outline Maps. Nine (various). (Oxford: Clarendon Press.) 1*d*. each.

Alternating-Current Electricity and its Applications to Industry. First Course. By W. H. Timbie and Prof. H. H. Higbie. Pp. x+534. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Studies of Trees. By J. J. Levison. Pp. x+253. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

Air, Water, and Food, from a Sanitary Standpoint. By A. G. Woodman and J. F. Norton. Fourth edition. Pp. v+248. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Electricity in Gases. By Prof. J. S. Townsend. Pp. xv+496. (Oxford: Clarendon Press.) 14*s*. net.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1915. (London: H. Greenwood and Co., Ltd.) 1*s*. net.

The Vicious Circles of Neurasthenia and their Treatment. By Dr. J. B. Hurry. Pp. xv+90. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

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A Text Book of General Physics for College Students: Electricity, Electromagnetic Waves, and Sound. By Prof. J. A. Culler. Pp. x+321. (Philadelphia and London: J. B. Lippincott Co.) 7*s*. 6*d*. net.

The Royal Botanic Society of London Pocket Book. Pp. 62. (London: Royal Botanic Society.) 1*s*.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—Discontinuous Fluid Motion Past a Bent Plane, with Special Reference to Aeroplane Problems: Prof. G. H. Bryan and R. Jones.—A New Type of Series in the Band Spectrum Associated with Helium: Prof. A. Fowler.—The Spectra of Ordinary Lead and Lead of Radio-active Origin: T. R. Merton.—The Viscosity of the Vapour of Iodine: A. O. Rankine.

ROYAL INSTITUTION, at 3.—Modern Theories and Methods in Medicine Methods and Results: H. G. Plimmer.

LINNEAN SOCIETY, at 5.—A New, Well-petrified Fossil: Wood or Bark Angiosperm or Gymnosperm?: Dr. Marie Stopes.—Brachydactyly as an Example of Mendelian Inheritance: Dr. H. Drinkwater.

FRIDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 9.—Science and Industrial Problems: Prof. A. W. Crossley.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Presidential Address: Geological History of Flying Vertebrates: G. W. Young.

MONDAY, FEBRUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Seventh Journey in Persia: Col. P. Molesworth Sykes, C.M.G.

TUESDAY, FEBRUARY 9.

ZOOLOGICAL SOCIETY, at 5.30.—Exhibition of Skins of Mammals from Sierra Leone: Guy Aylmer.—Exhibitions of Skiagraphs of Foraminifera: E. Heron-Allen.—Report on the Deaths which occurred in the Zoological Gardens during 1914: H. G. Plimmer.—A Colubrid Snake (Xenodon) with a Vertically Movable Maxillary Bone: E. G. Boulenger.—A New Liver-fluke from the Kestrel: W. Nicoll.

ROYAL INSTITUTION, at 3.—Muscle in the Service of Nerve: Prof. C. S. Sherrington.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Engineering Operations for the Prevention of Malaria: F. D. Evans.

WEDNESDAY, FEBRUARY 10.

ROYAL SOCIETY OF ARTS, at 8.—British Lithography in 1915: F. V. Brooks.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers: Lepidostrobus Kentuckiensis*, formerly *Lepidostrobus Fischeri*, Scott and Jeffrey; A Correction: Dr. D. H. Scott.—The Excitatory Process in the Dog's Heart. II.: The Ventricles: T. Lewis and M. A. Rothschild.—The Variation in the Growth of Mammalian Tissue *in vitro* according to the Age of the Animal: A. J. Walton.

ROYAL INSTITUTION, at 3.—Nations as Species: Dr. P. Chalmers Mitchell.

INSTITUTION OF ELECTRICAL ENGINEERS at 8.—Conditions Affecting the Variation in Strength of Wireless Signals: Prof. E. W. Marchant.

CHILD STUDY SOCIETY, at 6.—With the British Association in Australia: Dr. C. W. Kimmins.

ROYAL SOCIETY OF ARTS, at 4.30.—Tribes of the Brahmaputra Valley: Capt. Sir George D. Dunbar, Bart.

FRIDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 9.—Recent Advances in Oceanography: Dr. W. S. Bruce.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—The Criterion of Steel Suitable for Permanent Magnets: Prof. Silvanus P. Thompson.—A Galvanic Cell which Reverses its Polarity when Illuminated: Alan A. Campbell Swinton.—An Investigation on the Photographic Effect of Recoil Atoms: A. B. Wood and A. I. Steven.

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